# Figure 1

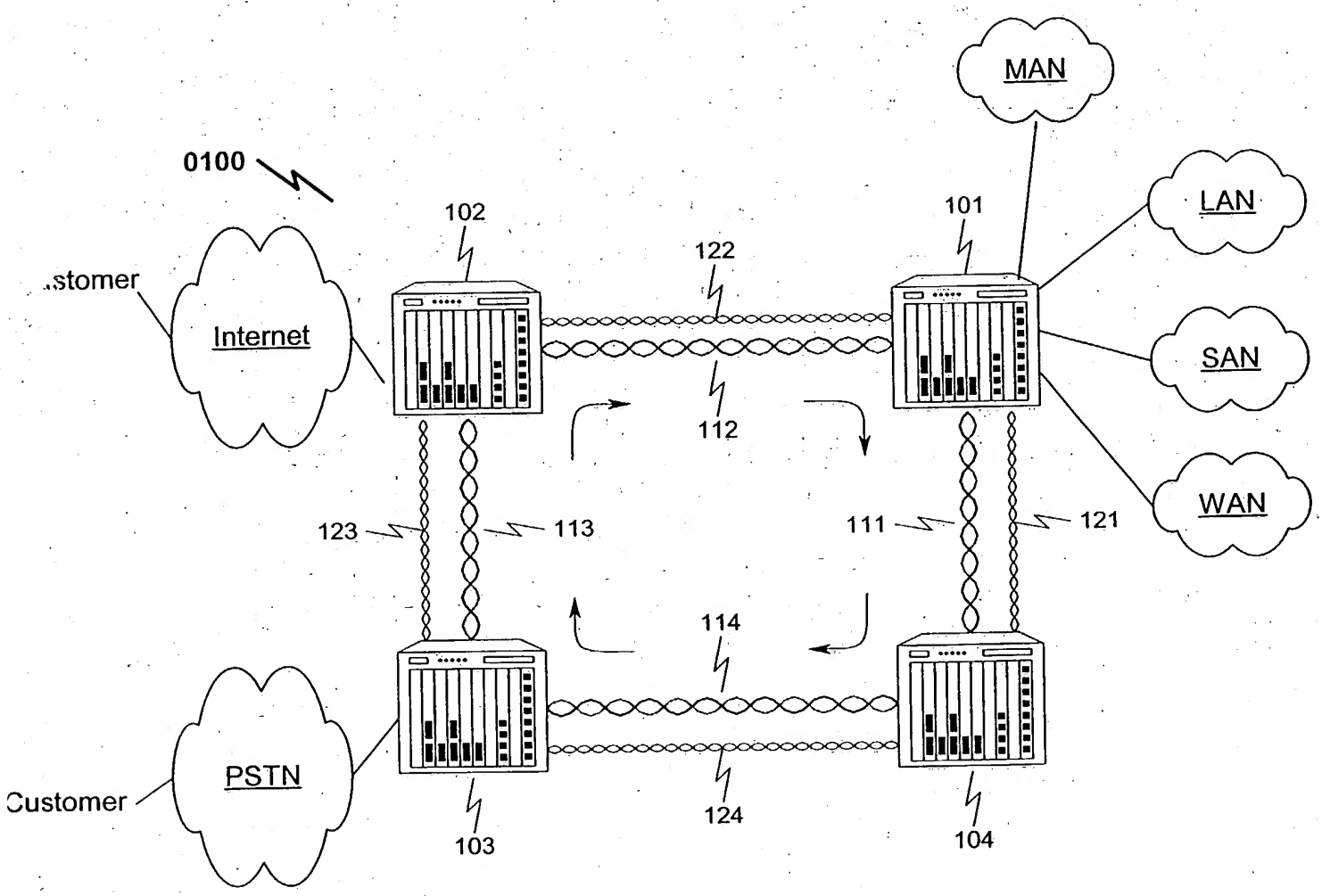
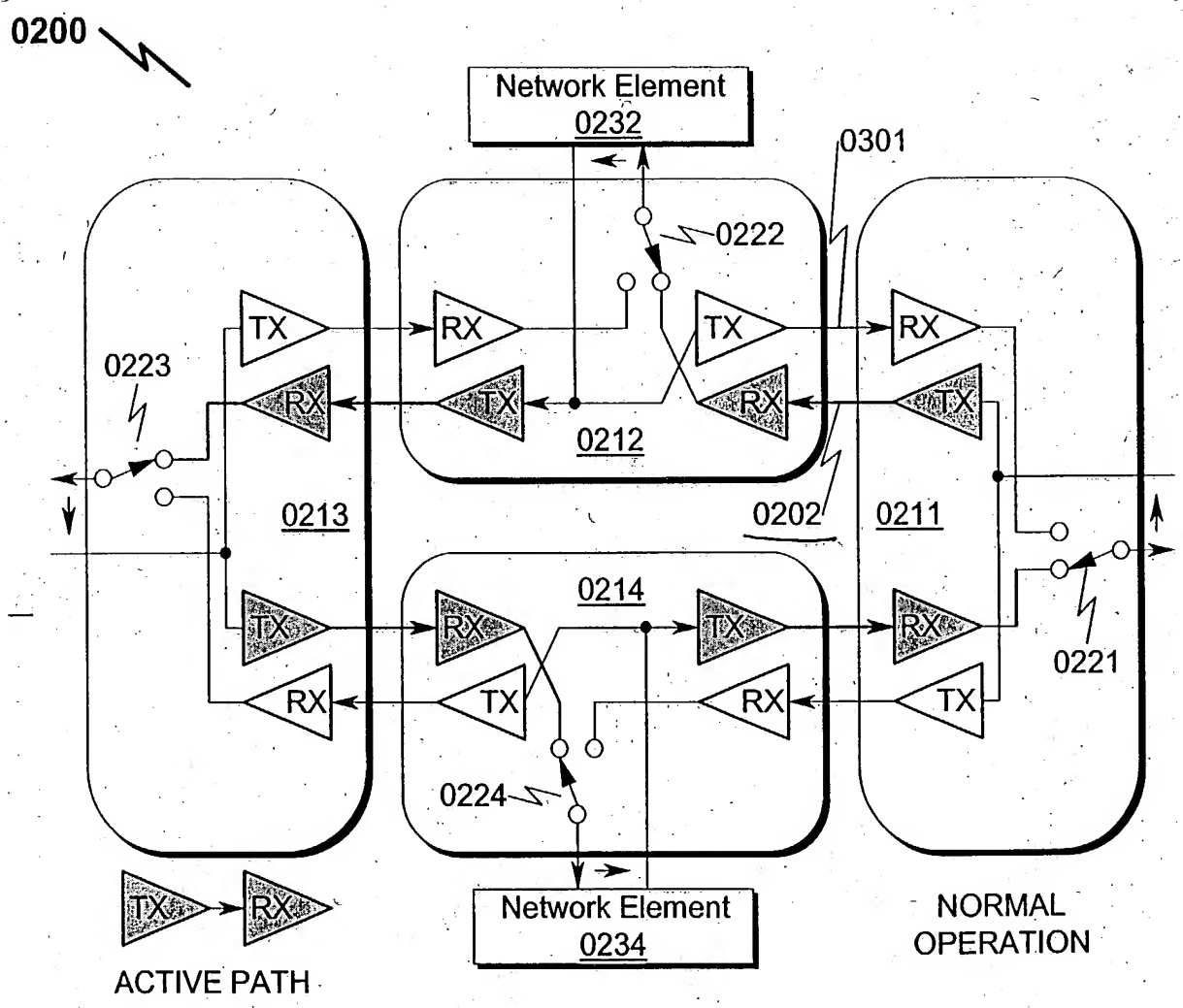

MAN
0100
LAN
102
101
122
.stomer
Internet
SAN
112
WAN
123
113
111
121
114
PSTN
Customer
124
103
104

Figure 2




***PRIOR ART***

2017.

Figure 3

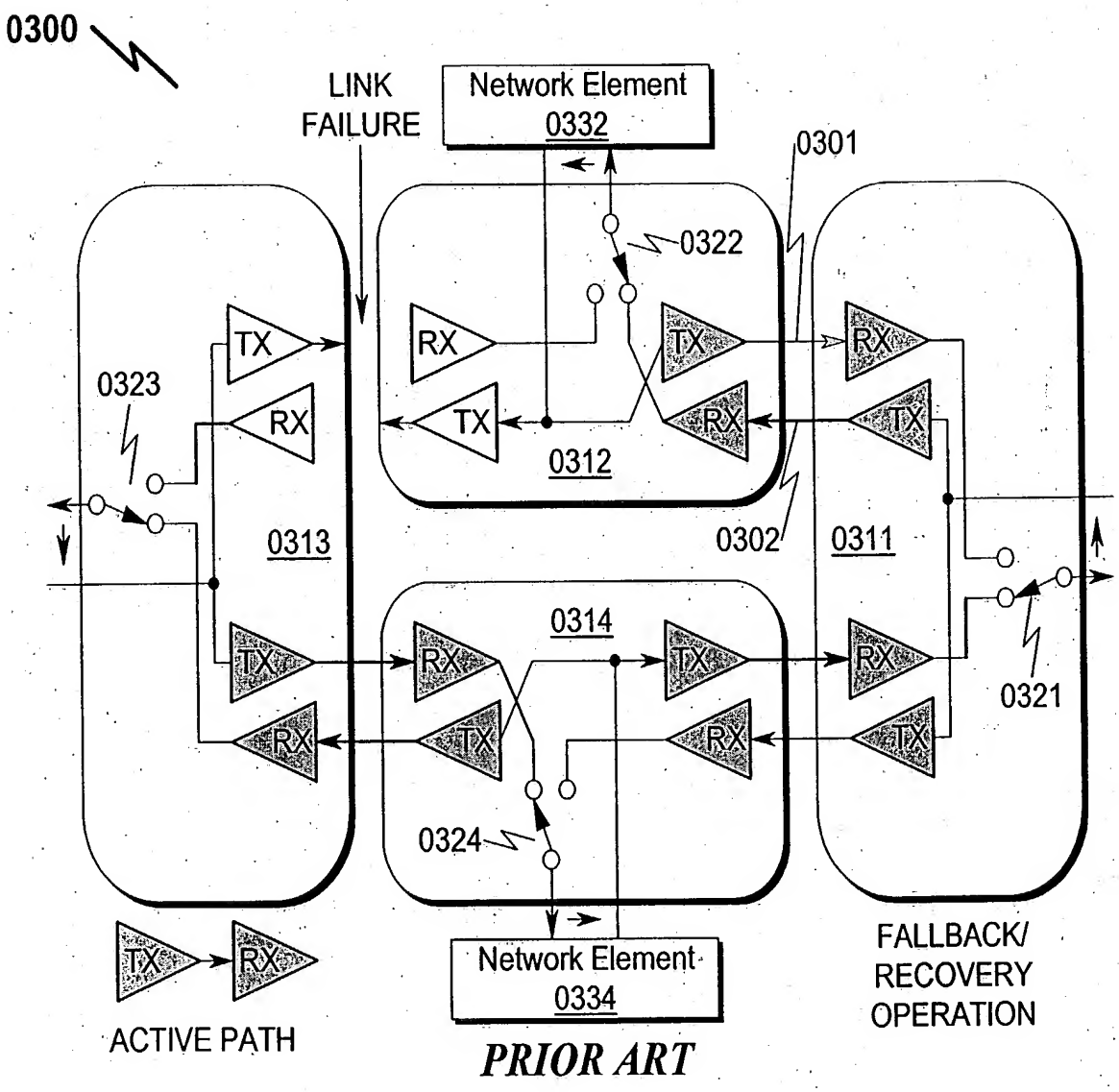
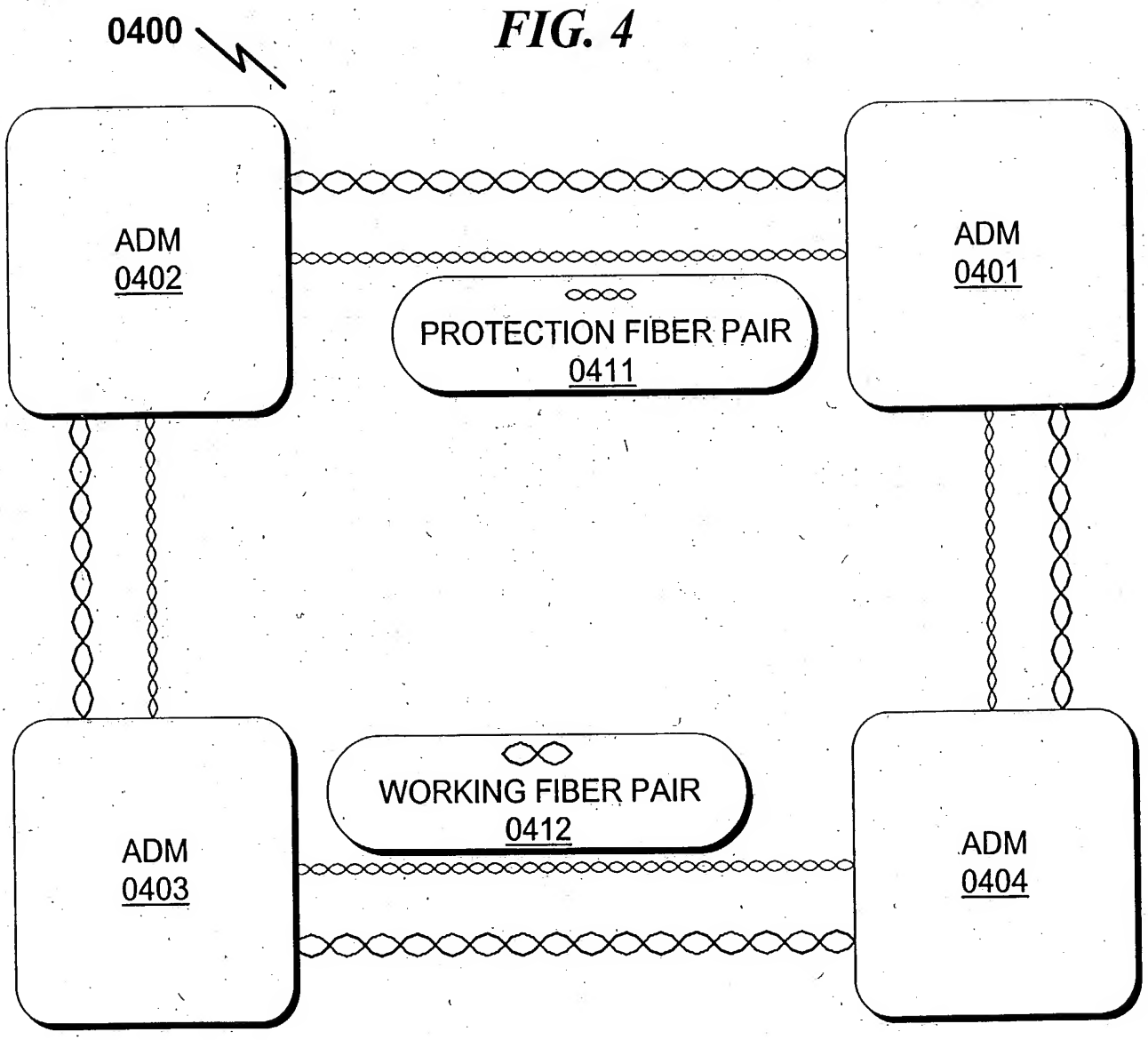

0300
LINK FAILURE
Network Element 0332
0301
0322
TX
RX
0323
0312
0313
0302
0311
0314
0321
0324
Network Element 0334
ACTIVE PATH
FALLBACK/ RECOVERY OPERATION
PRIOR ART

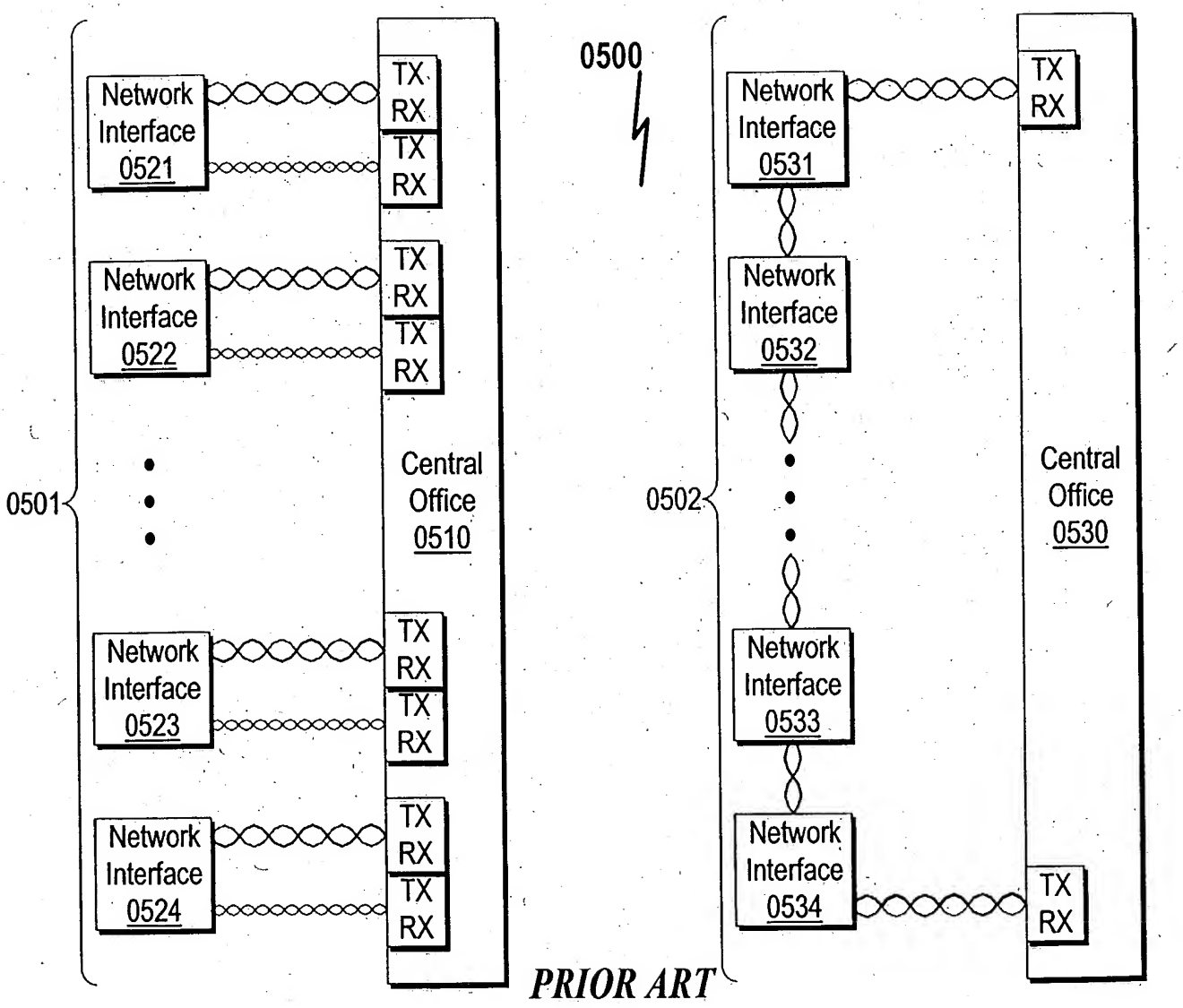
Figure 4

*FIG. 4*




*PRIOR ART*

Figure 5




*PRIOR ART*

Figure 6

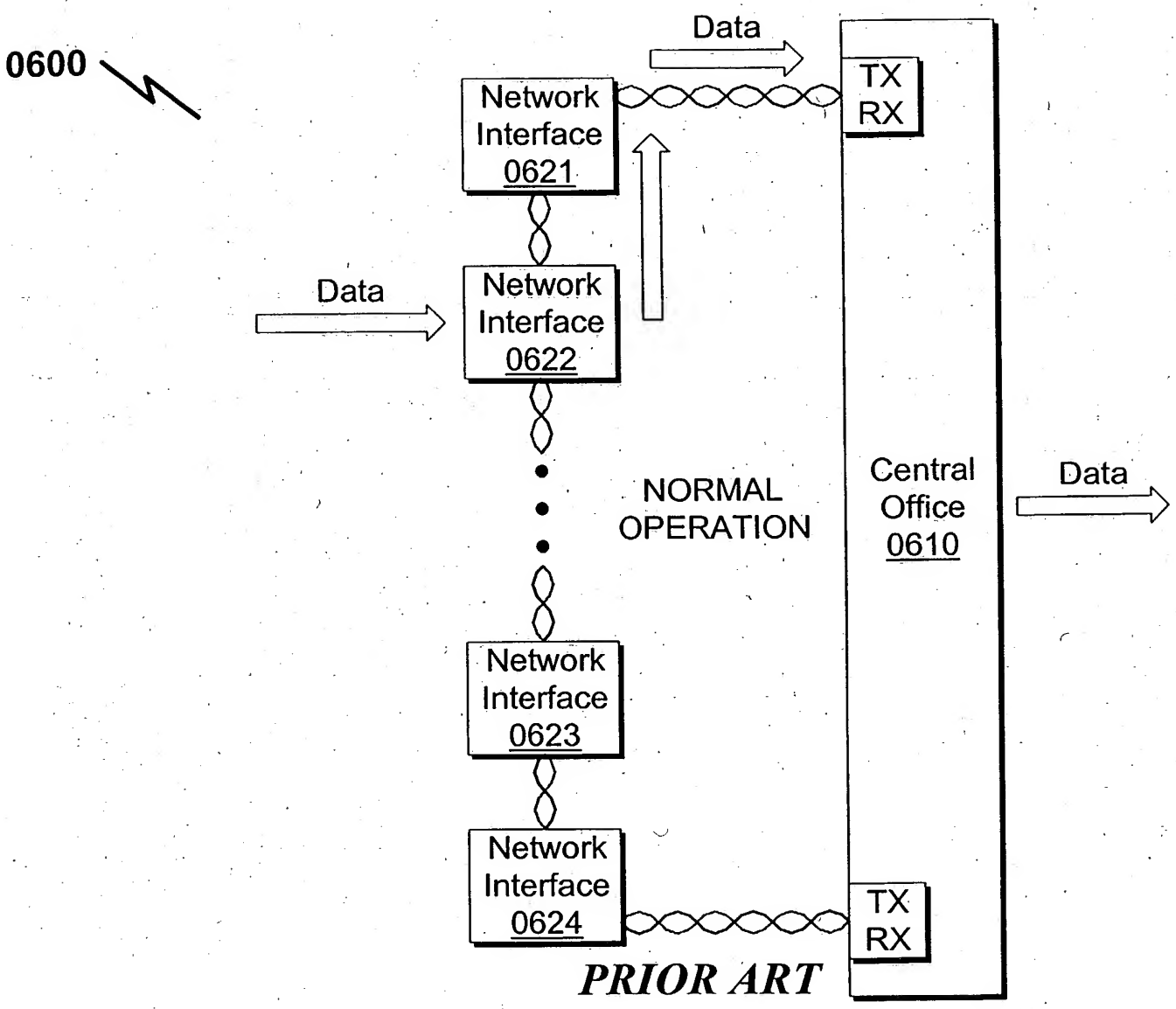

0600
Data
Network Interface 0621
TX RX
Data
Network Interface 0622
NORMAL OPERATION
Central Office 0610
Data
Network Interface 0623
Network Interface 0624
TX RX
PRIOR ART

Figure 7

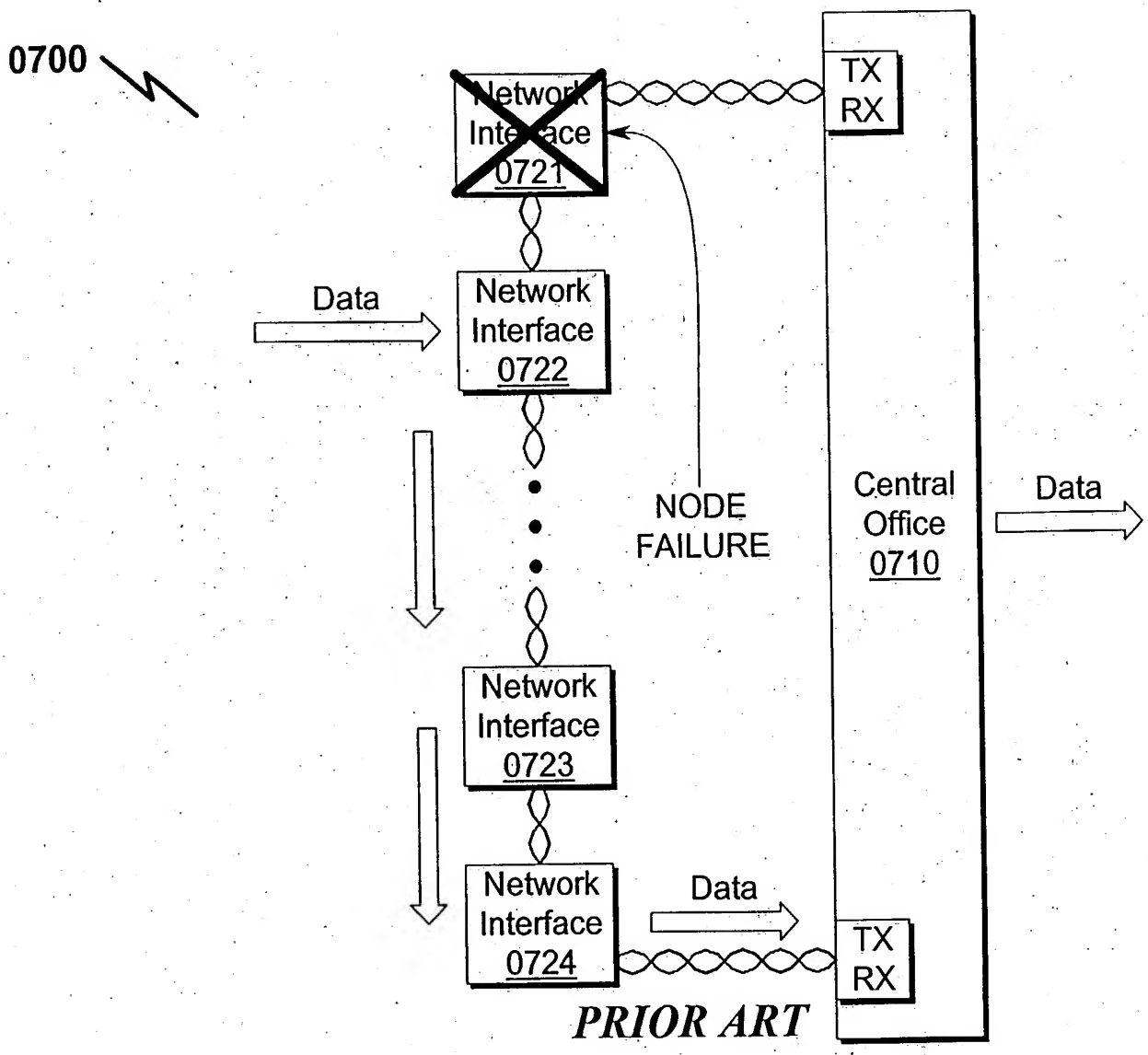

0700
Network Interface 0721
TX RX
Data
Network Interface 0722
NODE FAILURE
Central Office 0710
Data
Network Interface 0723
Network Interface 0724
Data
TX RX
PRIOR ART

Figure 8

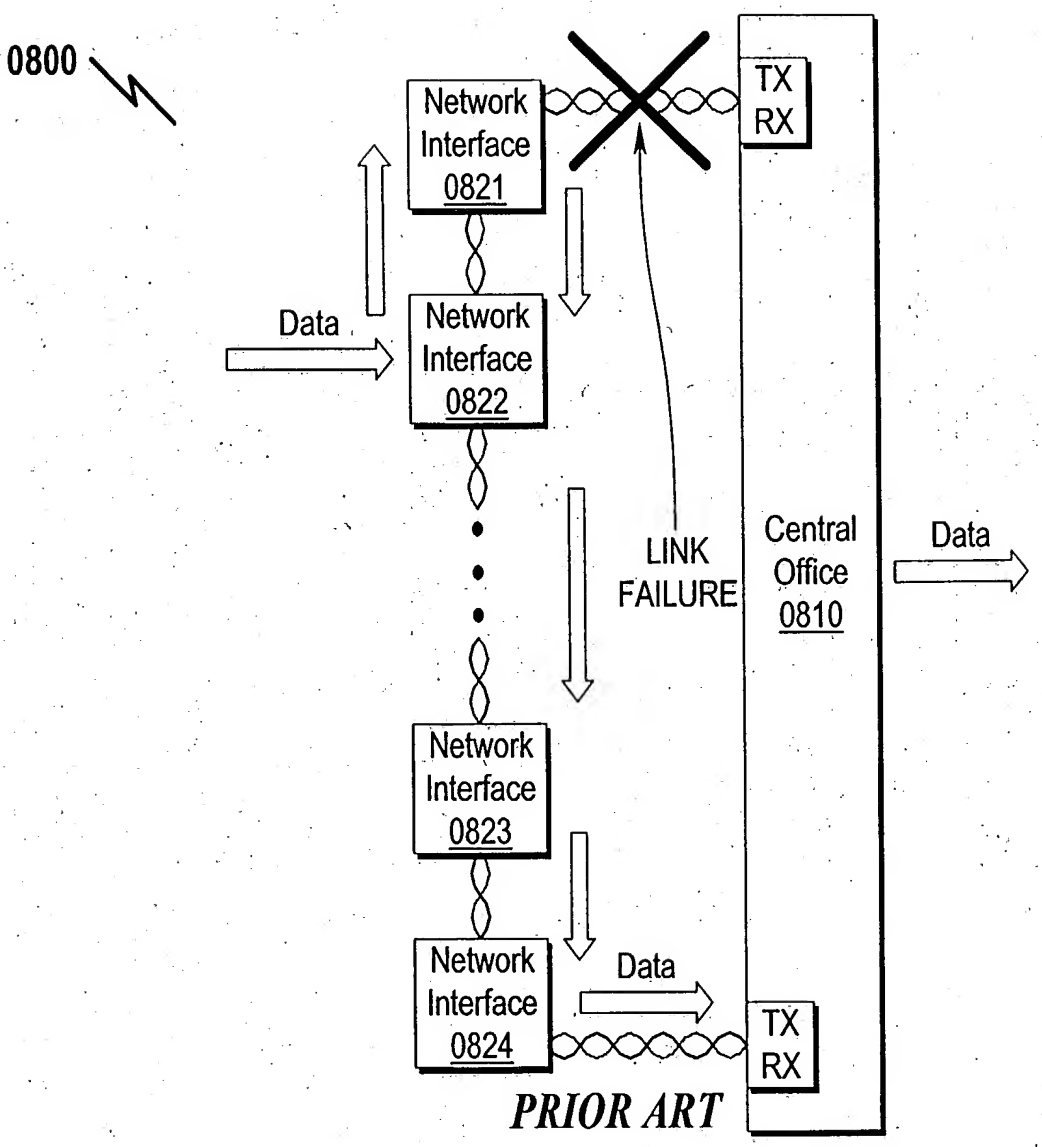
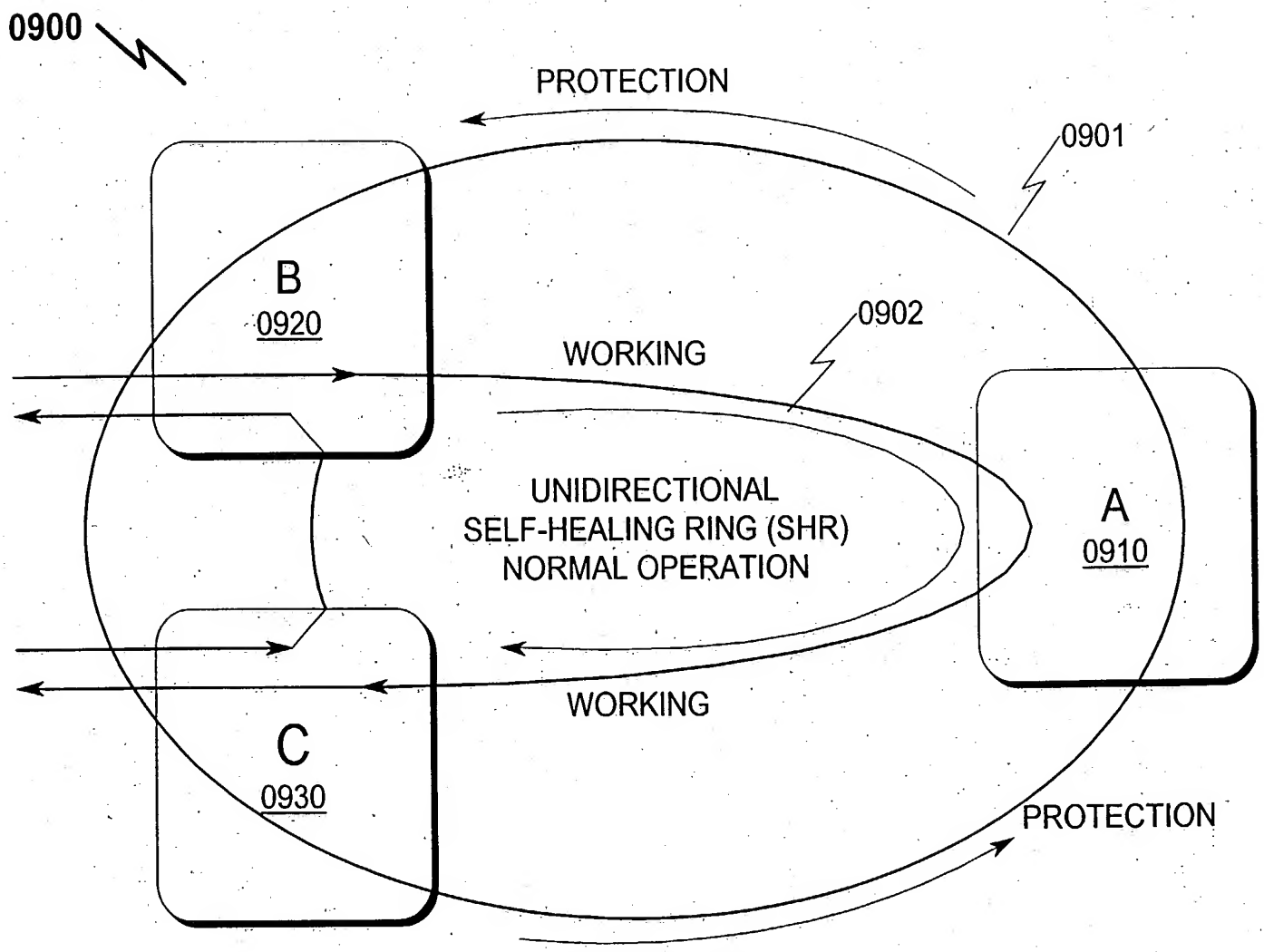
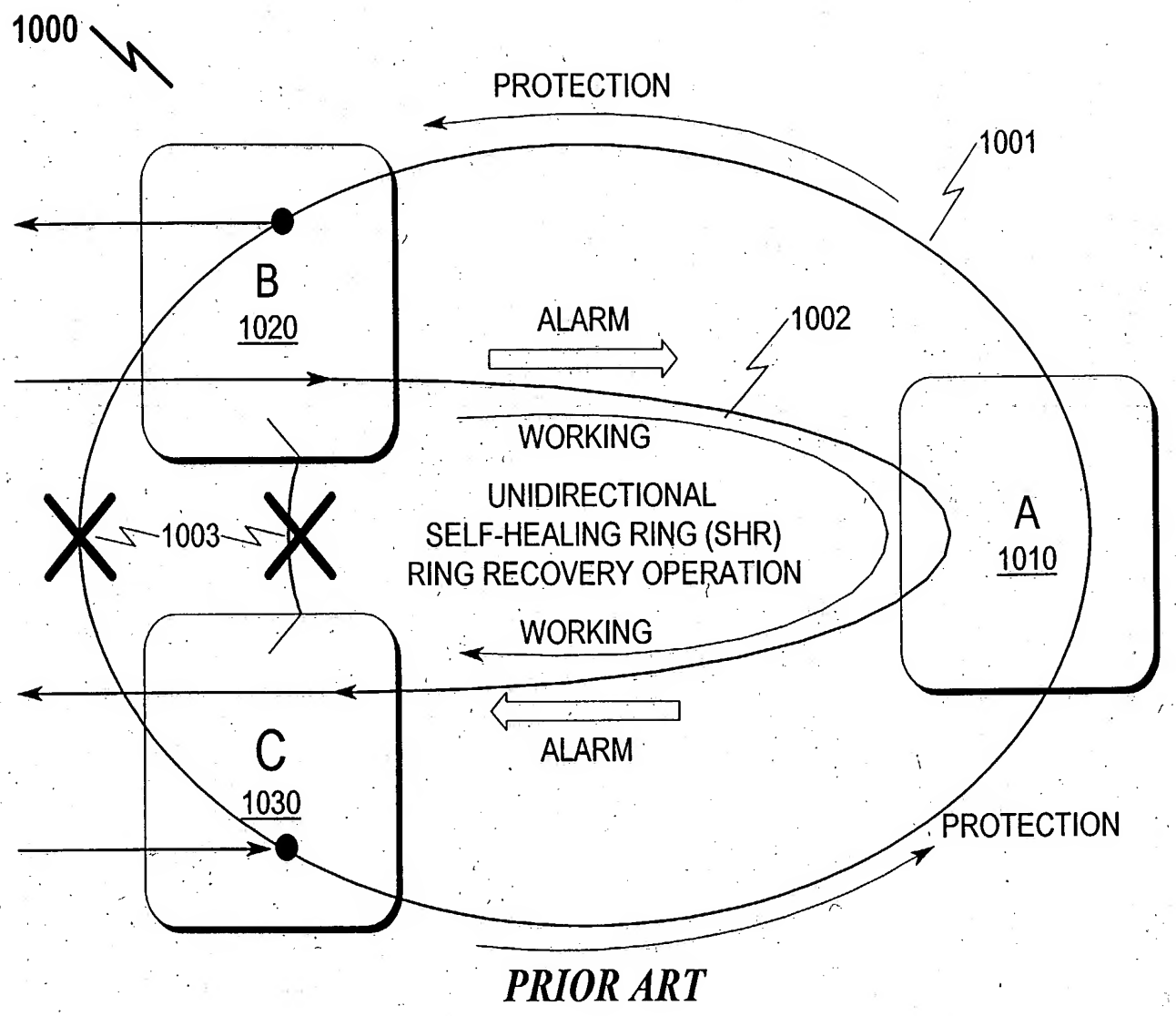

0800
Network Interface 0821
Network Interface 0822
Network Interface 0823
Network Interface 0824
TX RX
TX RX
Data
Data
Data
LINK FAILURE
Central Office 0810
PRIOR ART

Figure 9




*PRIOR ART*

Figure 10




*PRIOR ART*

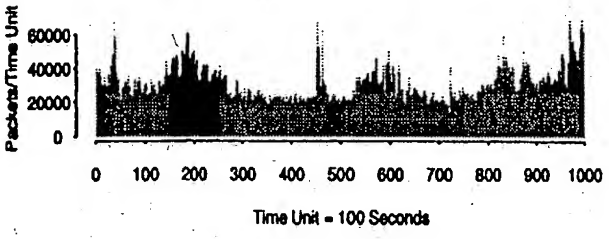
1100

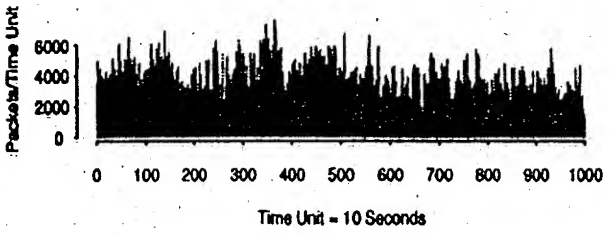
# Figure 11
# Prior Art

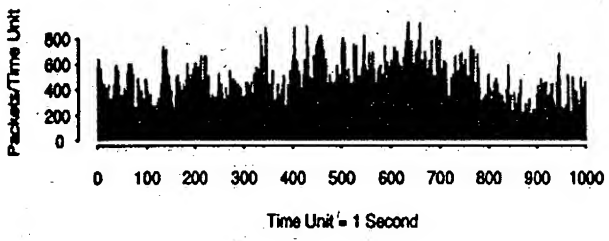
1102

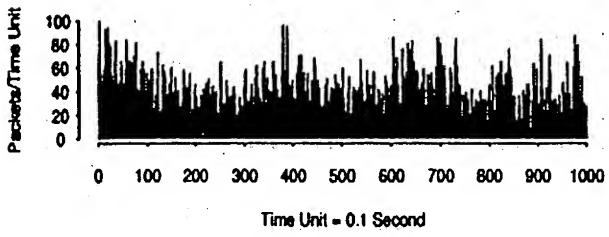
1104

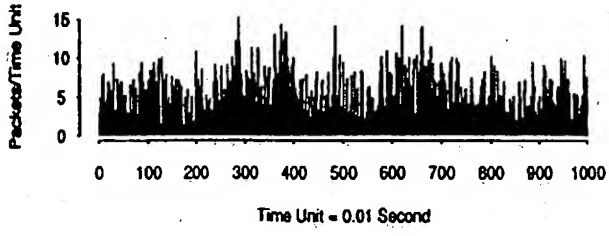
Measured Data Traffic (Ethernet LAN)



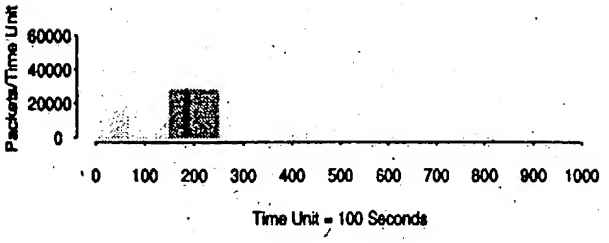



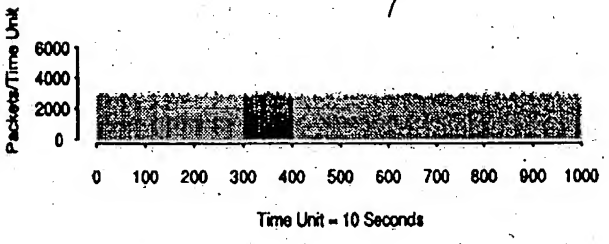



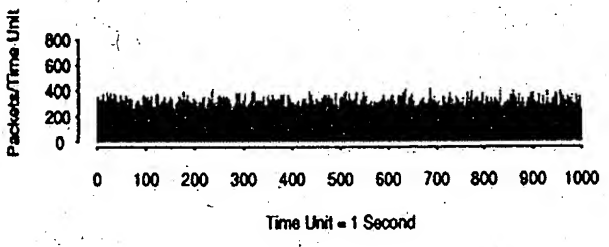



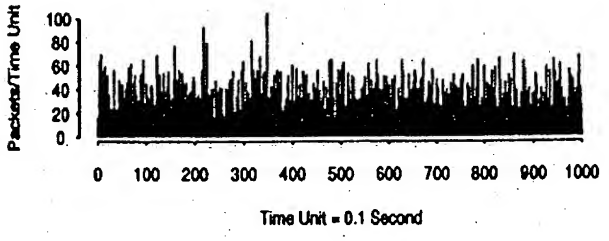

Traditional Models for Data Traffic

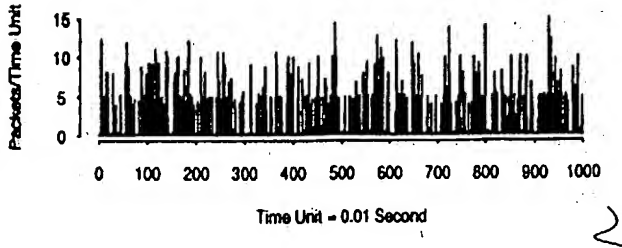



1112



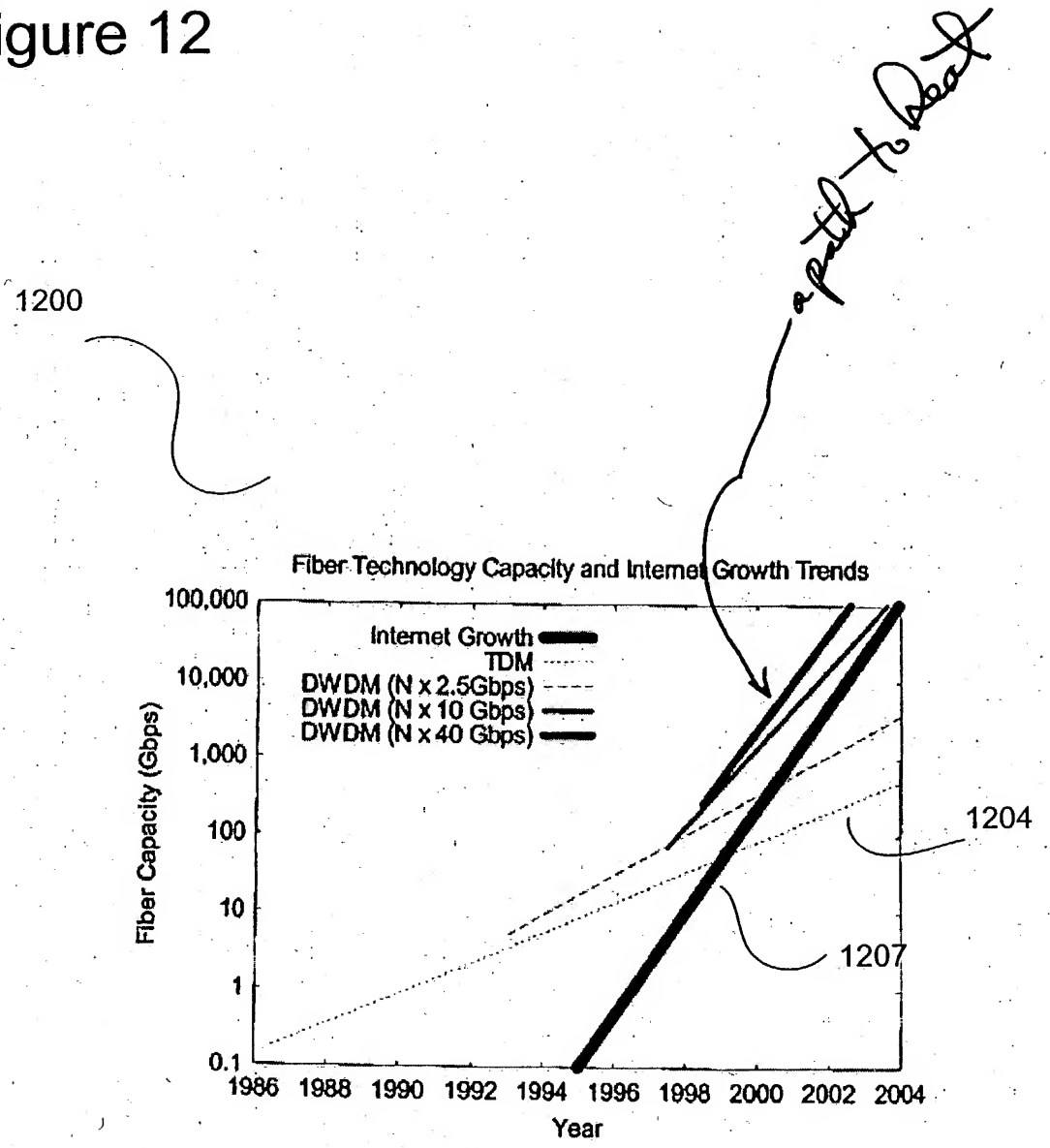




1110

Figure 12


1200
a path to beat
Fiber Technology Capacity and Internet Growth Trends
Internet Growth
TDM
DWDM (N x 2.5Gbps)
DWDM (N x 10 Gbps)
DWDM (N x 40 Gbps)
Fiber Capacity (Gbps)
100,000
10,000
1,000
100
10
1
0.1
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
Year
1204
1207

# Figure 13

1300

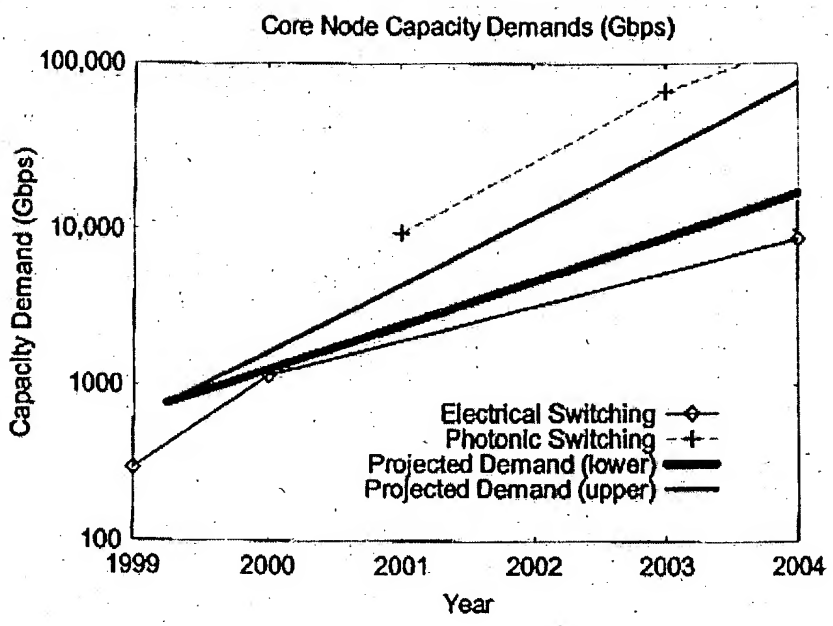
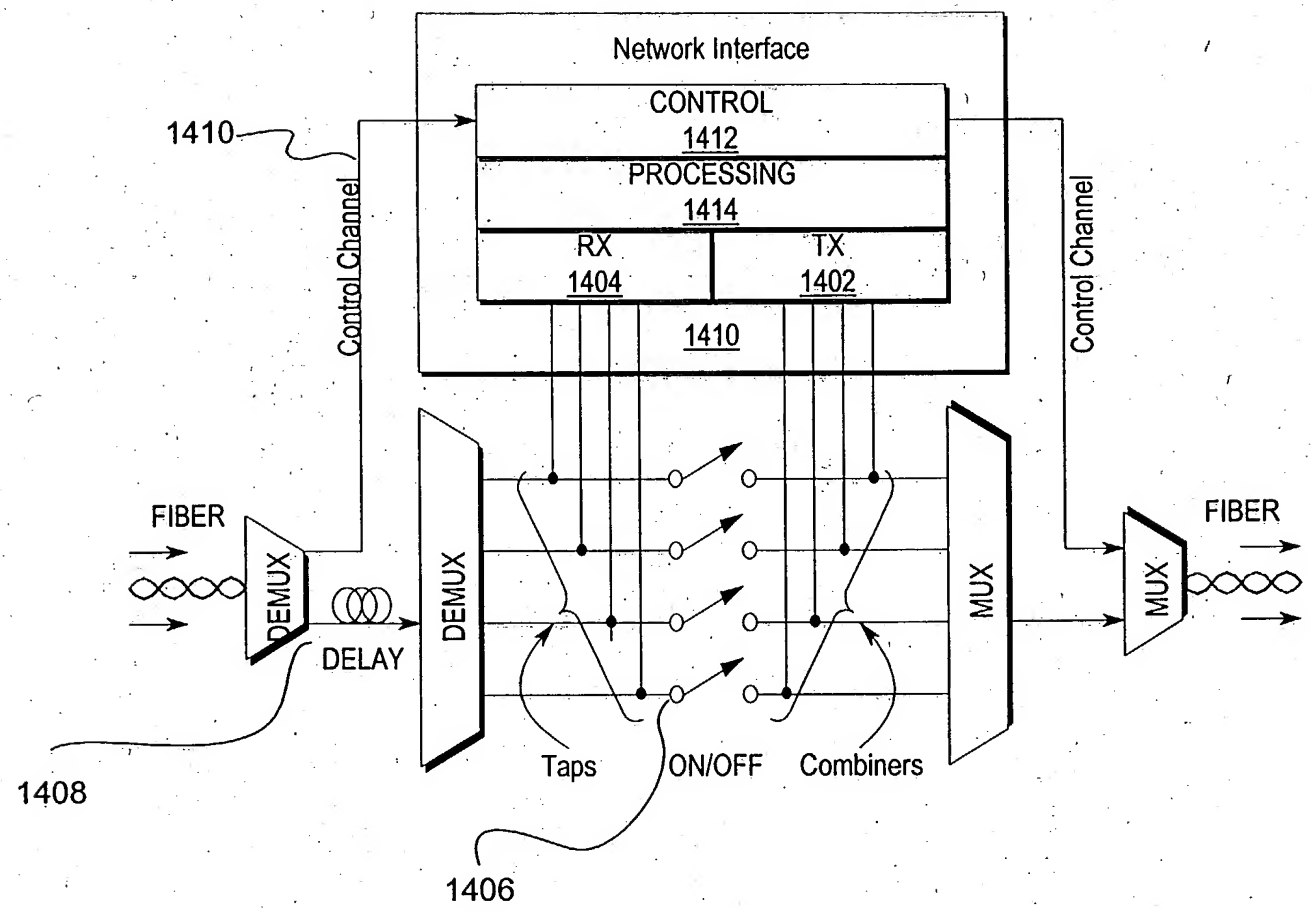


Figure 14




*PRIOR ART*

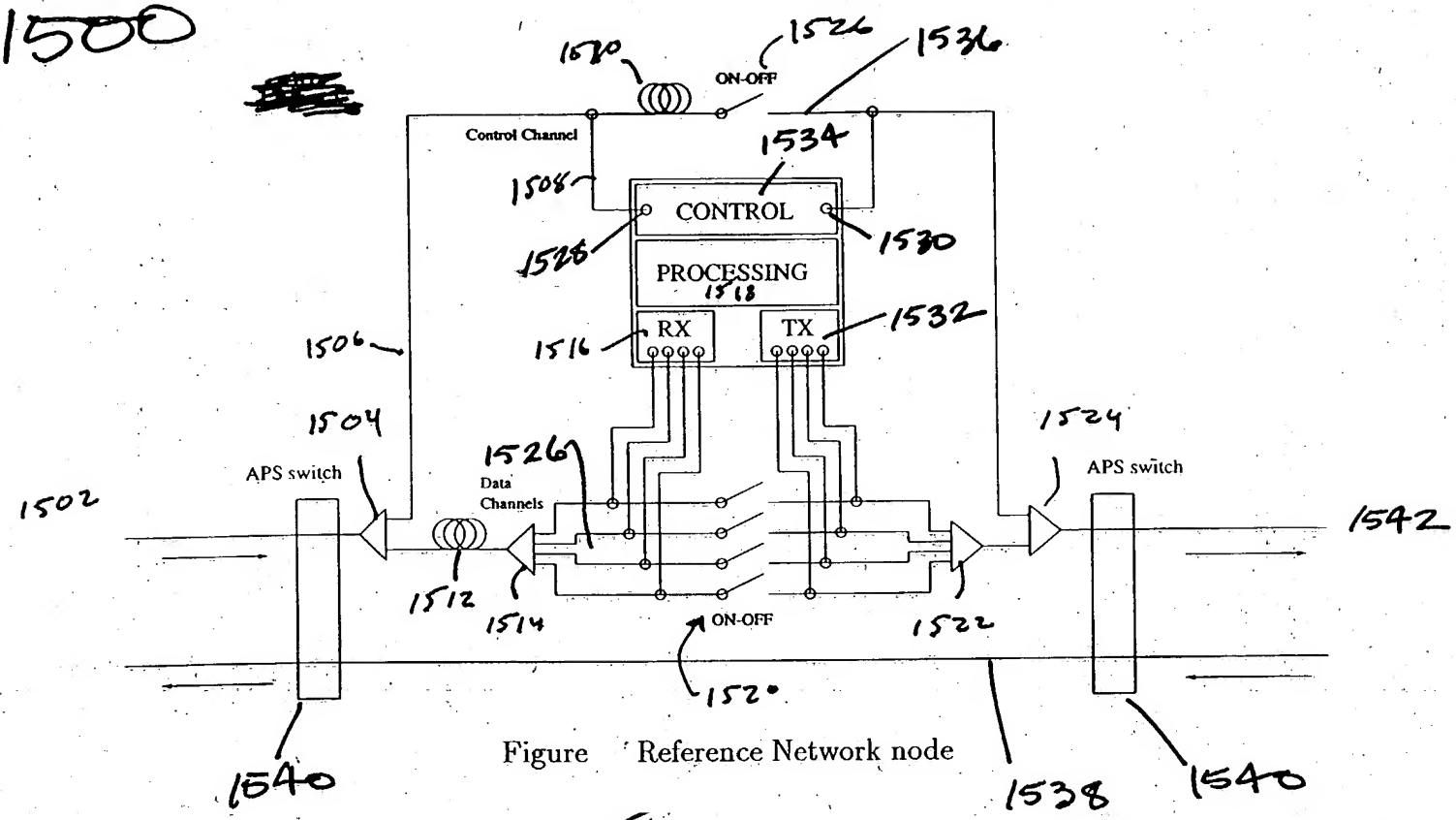


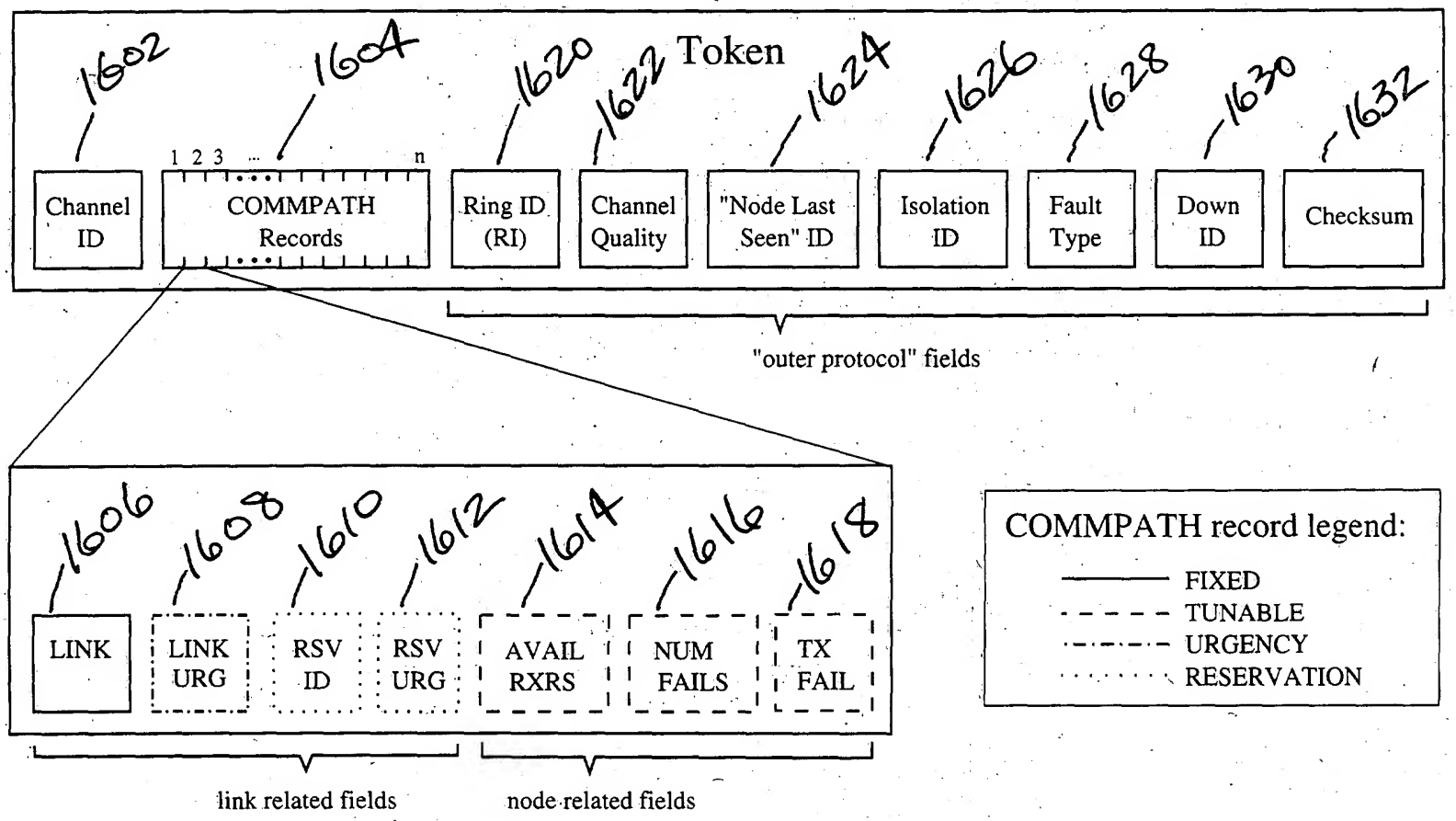

Figure Reference Network node

15:

f: nonnode

patent app #1

1600


Token
1602
1604
1620
1622
1624
1626
1628
1630
1632
1 2 3 ... n
Channel ID
COMMPATH Records
Ring ID (RI)
Channel Quality
"Node Last Seen" ID
Isolation ID
Fault Type
Down ID
Checksum
"outer protocol" fields
1606
1608
1610
1612
1614
1616
1618
LINK
LINK URG
RSV ID
RSV URG
AVAIL RXRS
NUM FAILS
TX FAIL
link related fields
node related fields
COMMPATH record legend:
FIXED
TUNABLE
URGENCY
RESERVATION

1700

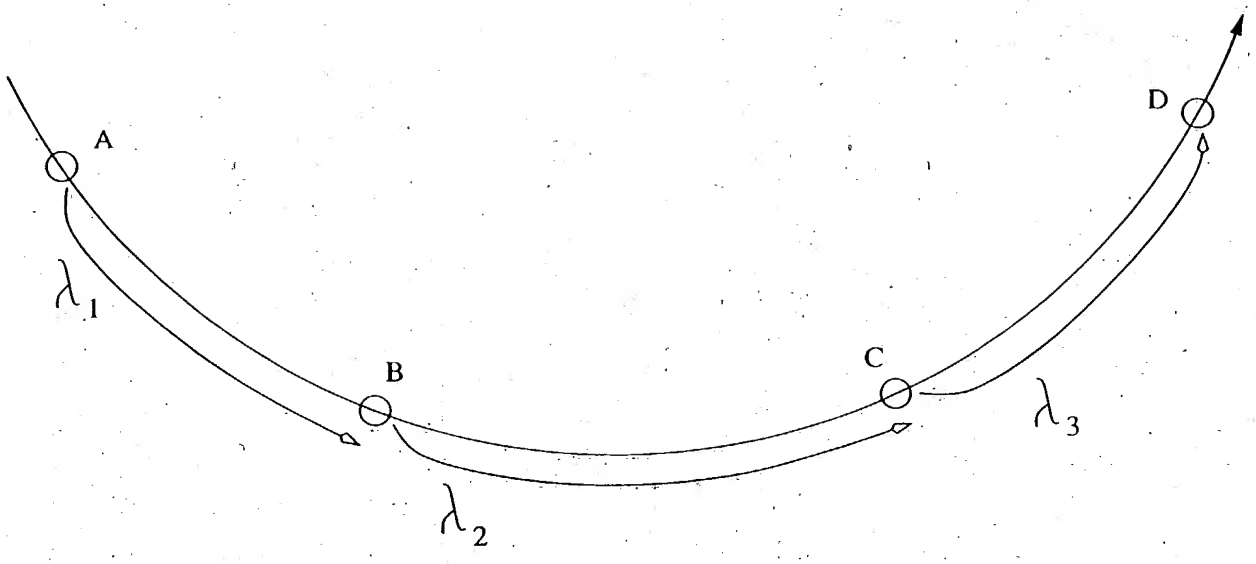



Figure Nodes A, B, and C contend for D's lone RXR

17

1700

f: RXR-contention

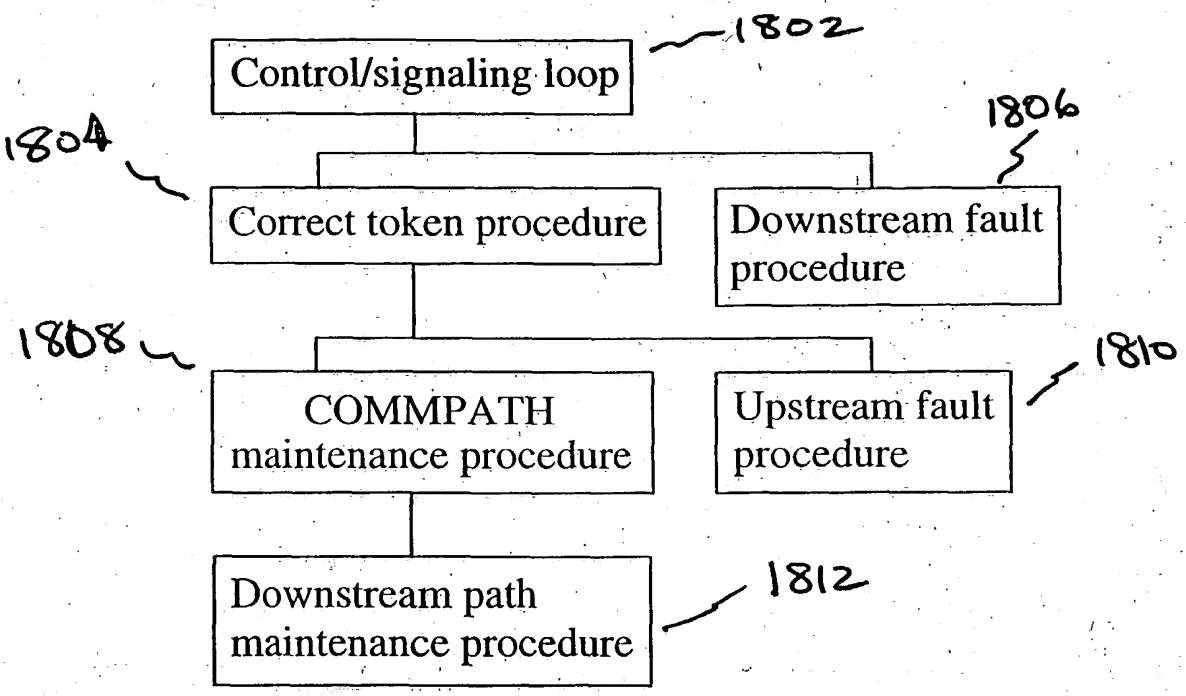
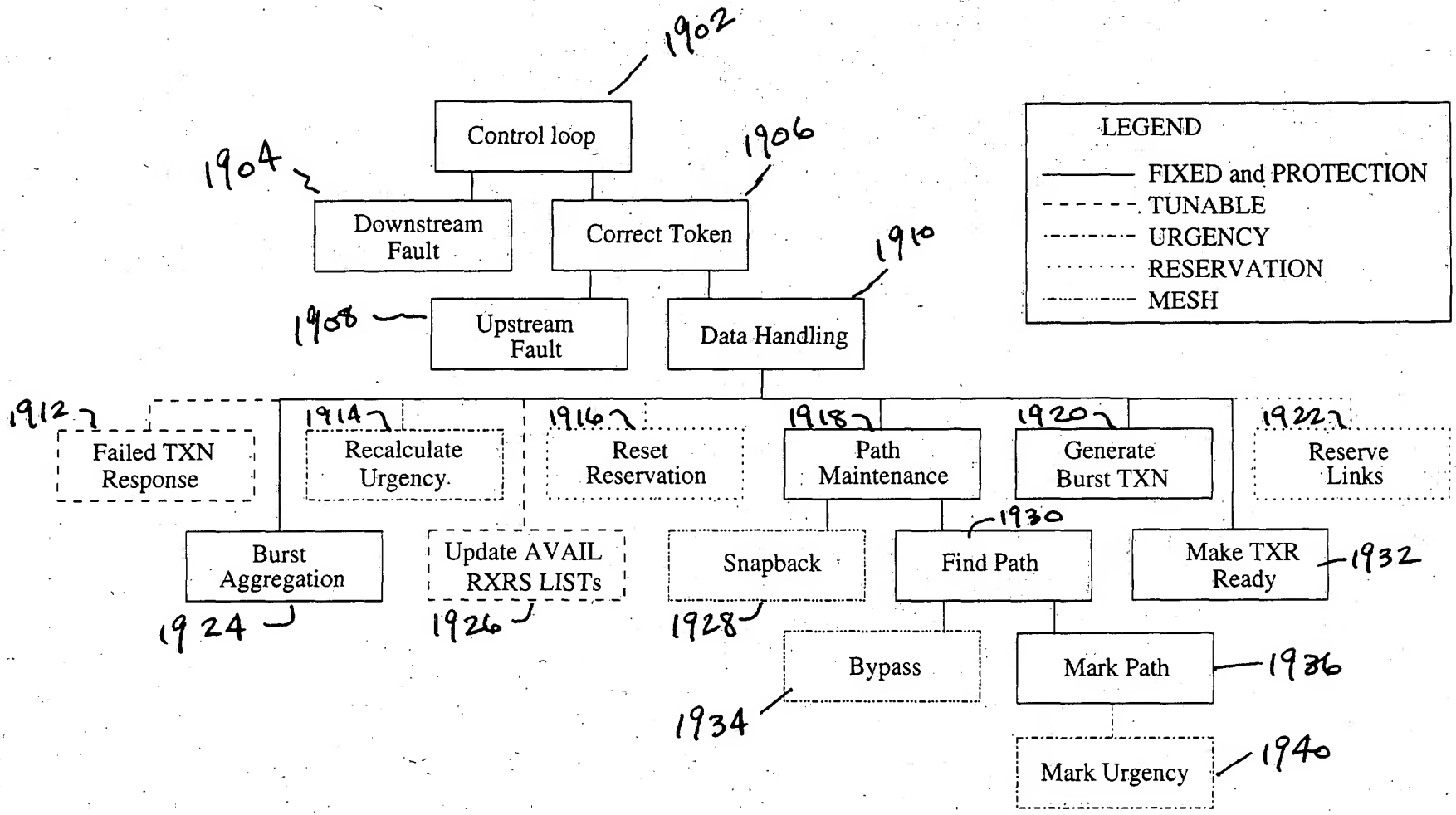



Figure Reference Network protocol procedure dependencies

18:

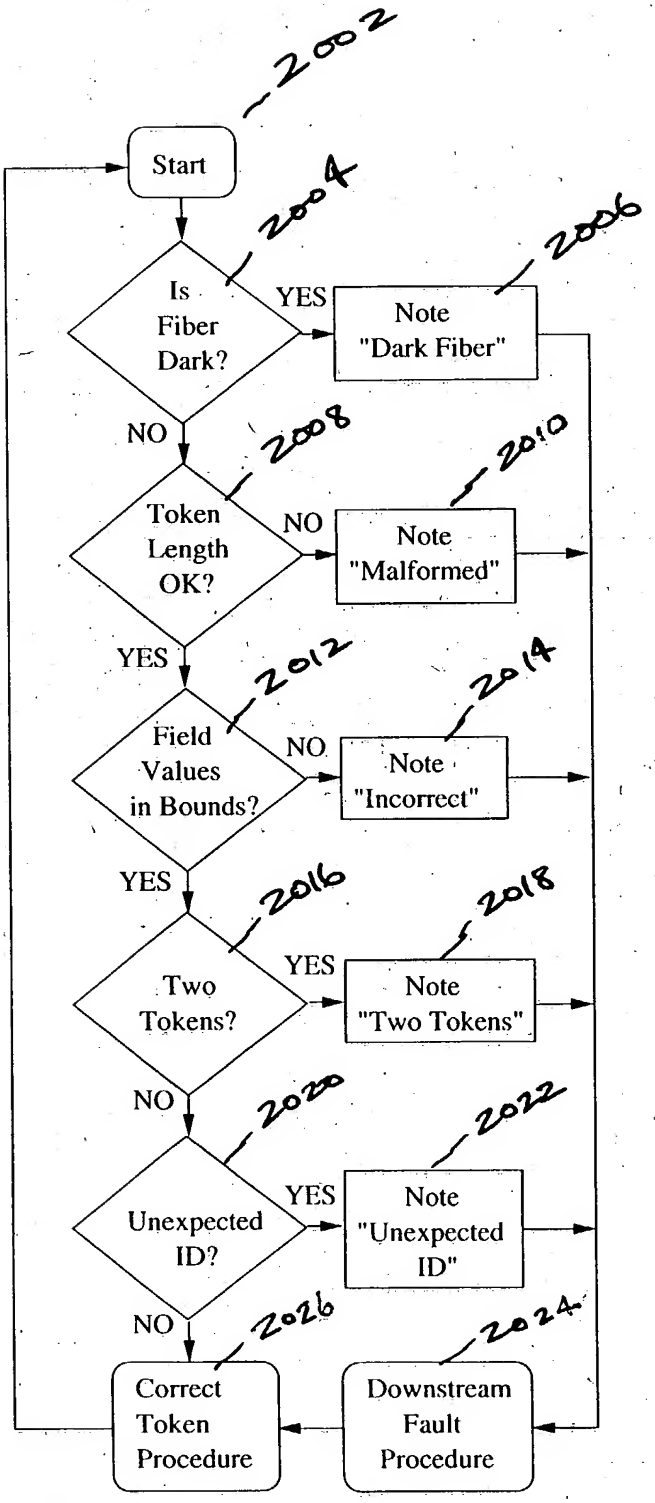
f:flow-ref-net-protocol-topview

1900



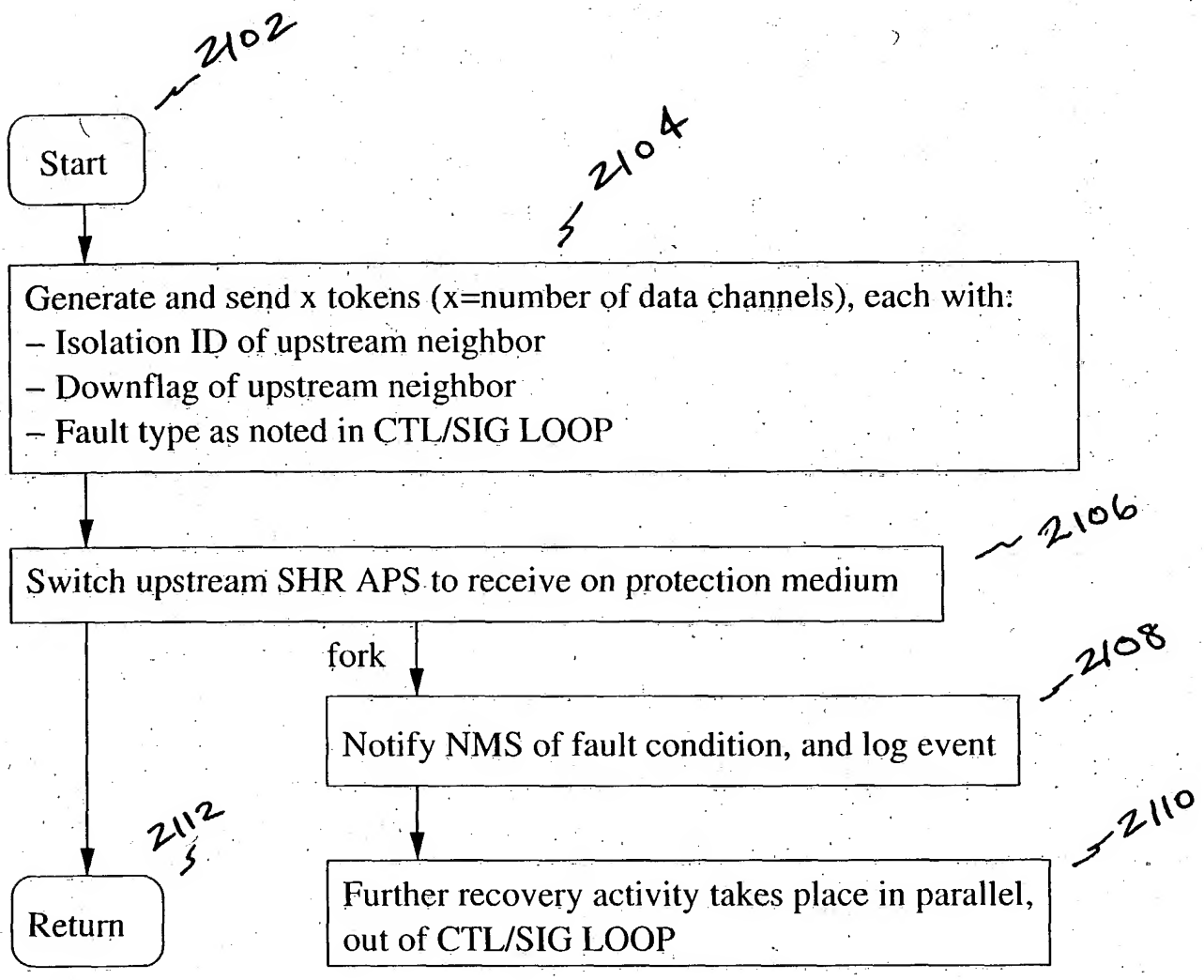

PROTOCOL PROCEDURE CALLING DEPENDENCIES

2000



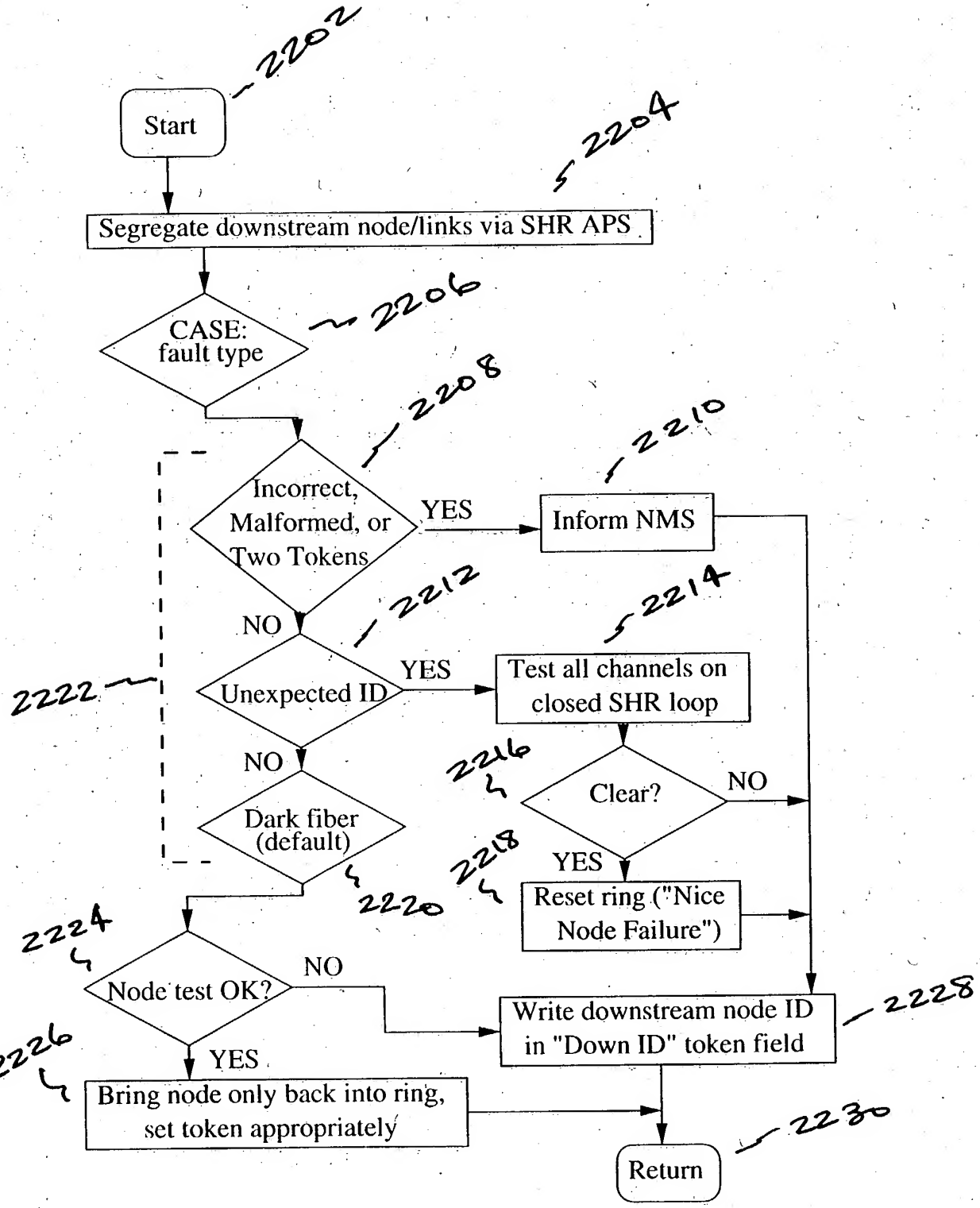

CONTROL/SIGNALING LOOP

2100



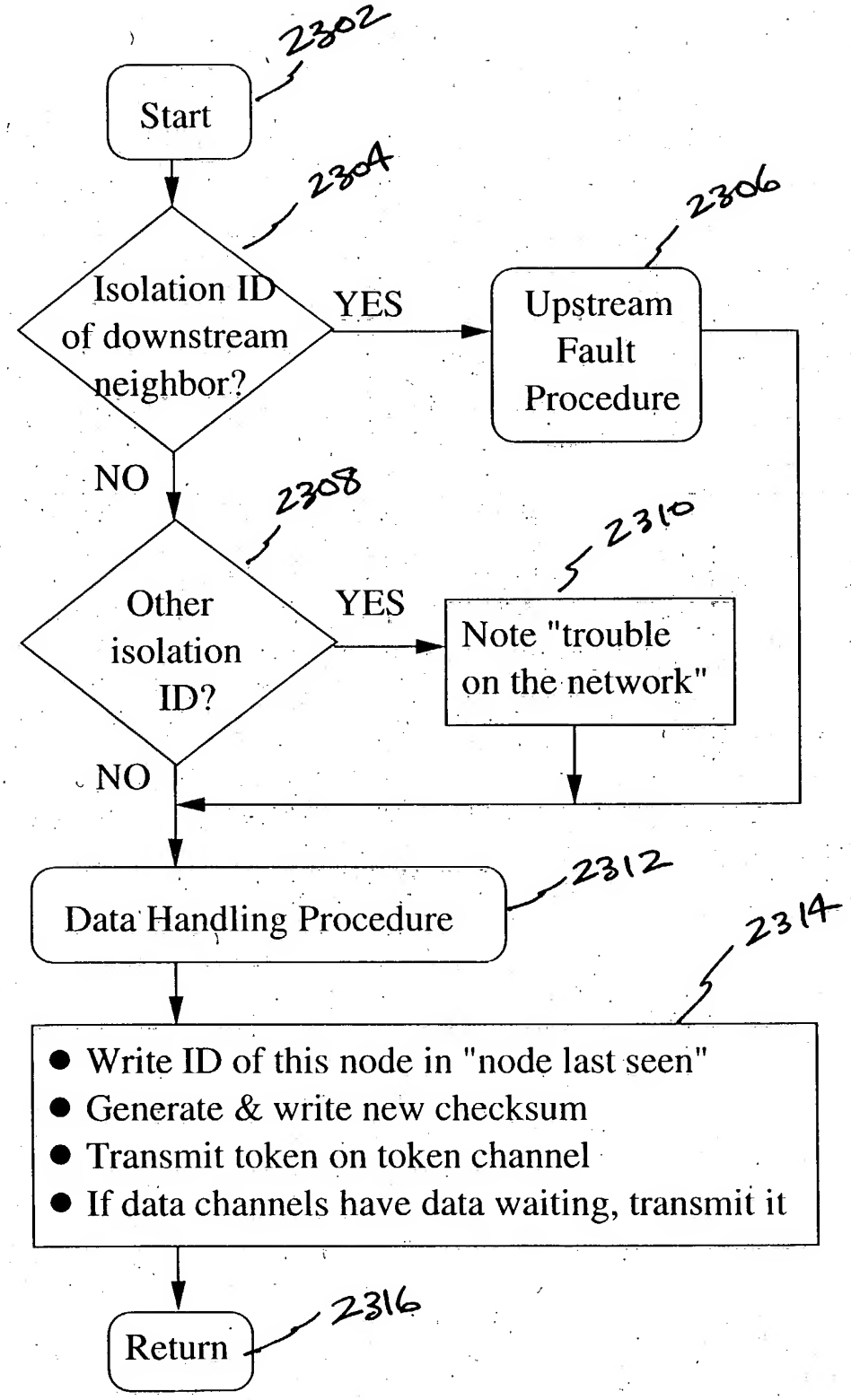

DOWNSTREAM FAULT PROCEDURE

2200

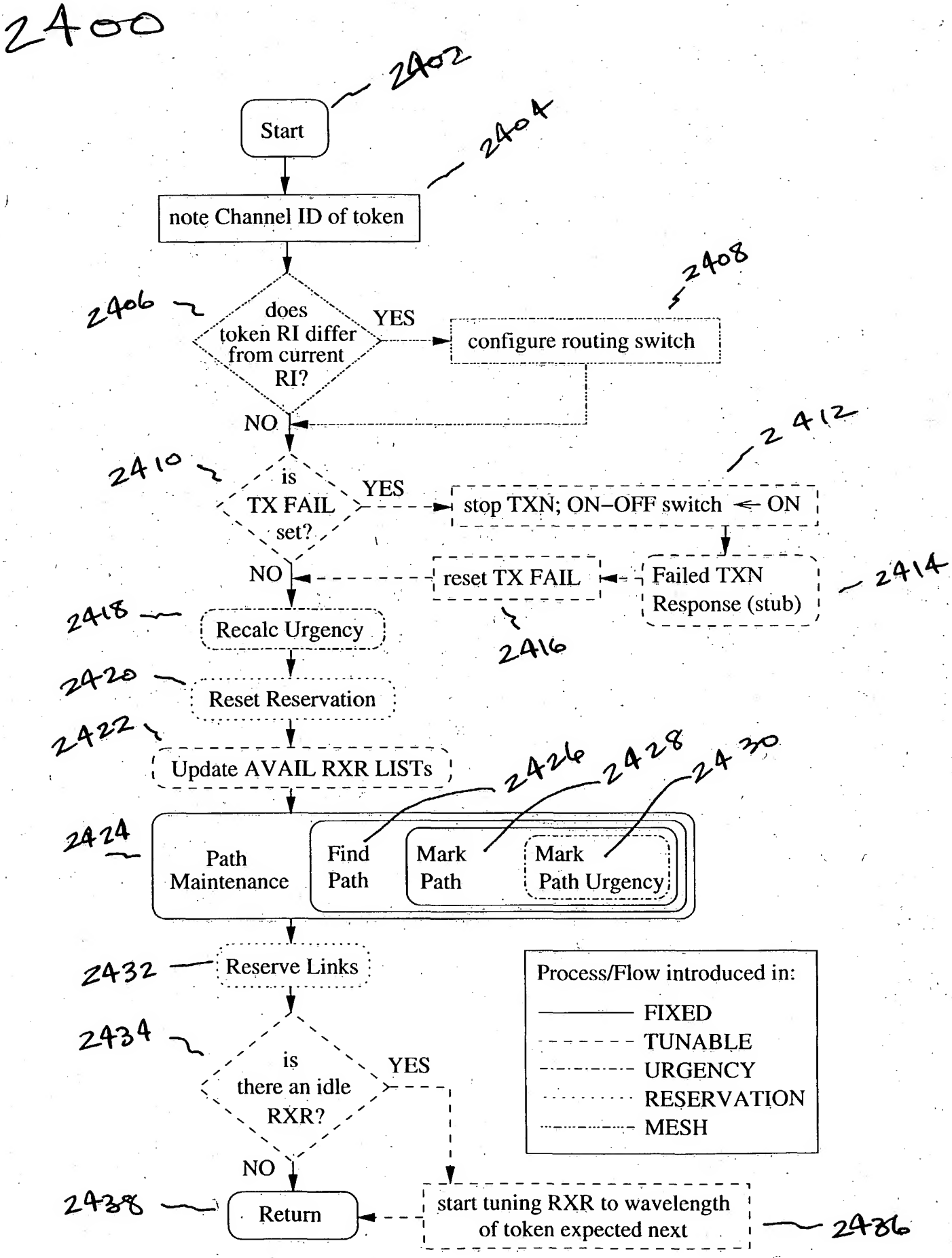



UPSTREAM FAULT PROCEDURE

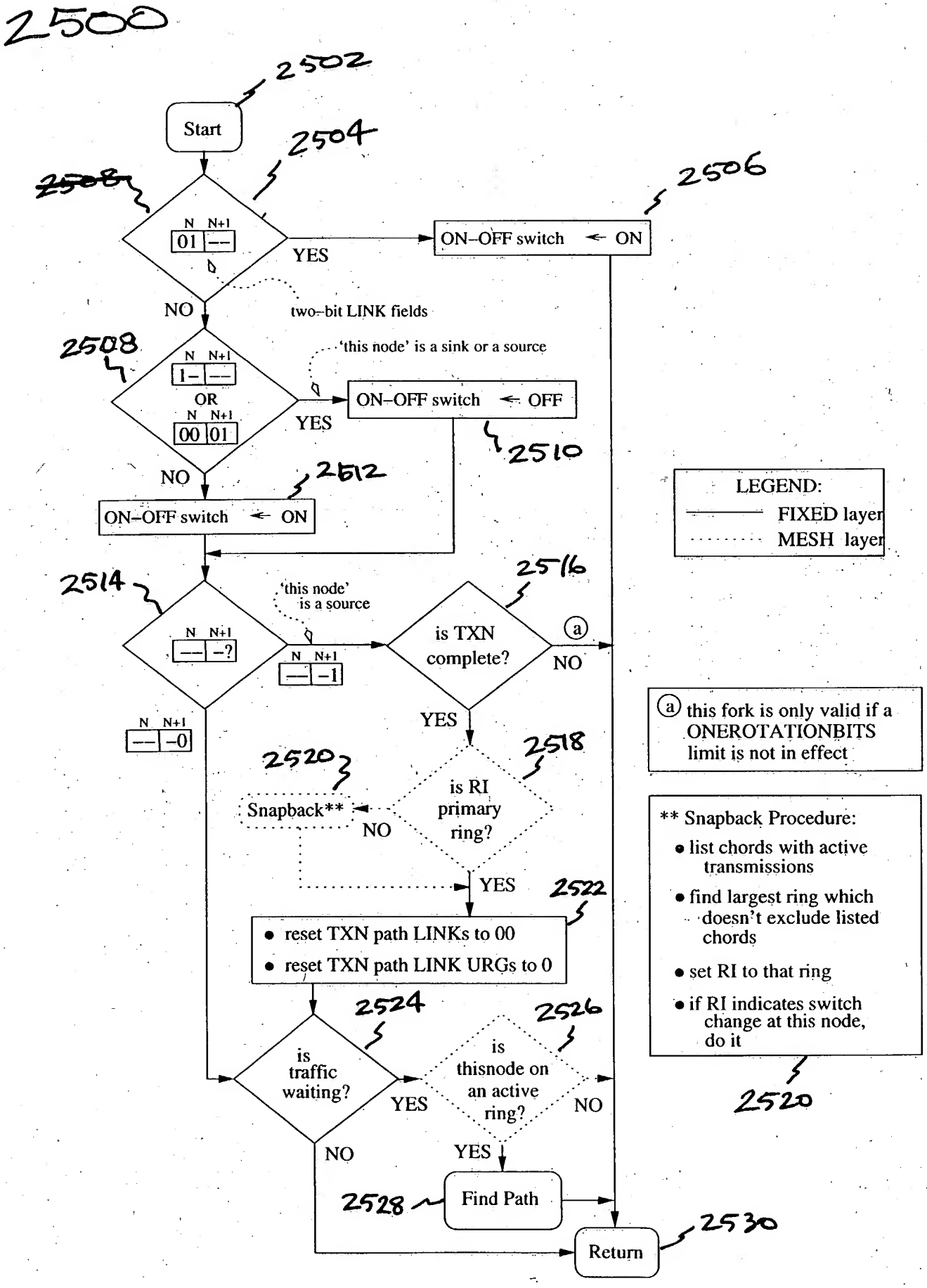
2300




CORRECT TOKEN PROCEDURE




DATA HANDLING




PATH MAINTENANCE

2600

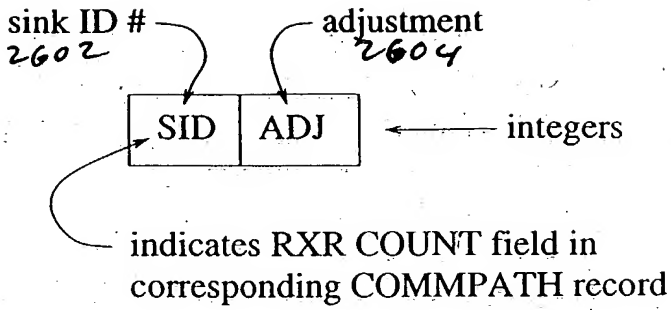



Figure RXR COUNT LIST record fields

26:

f: flow2-rxr-count-list-record

2700

**Algorithm 0.0.2:** UPDATE AVAIL RXR LISTS(*Global*, *Node*, *Token*)

**if** *rxr_lists* are empty [block 0]
  **then return**

**if** *Node* is on a lightpath [block 1]
  **then** note *source* and *sink*

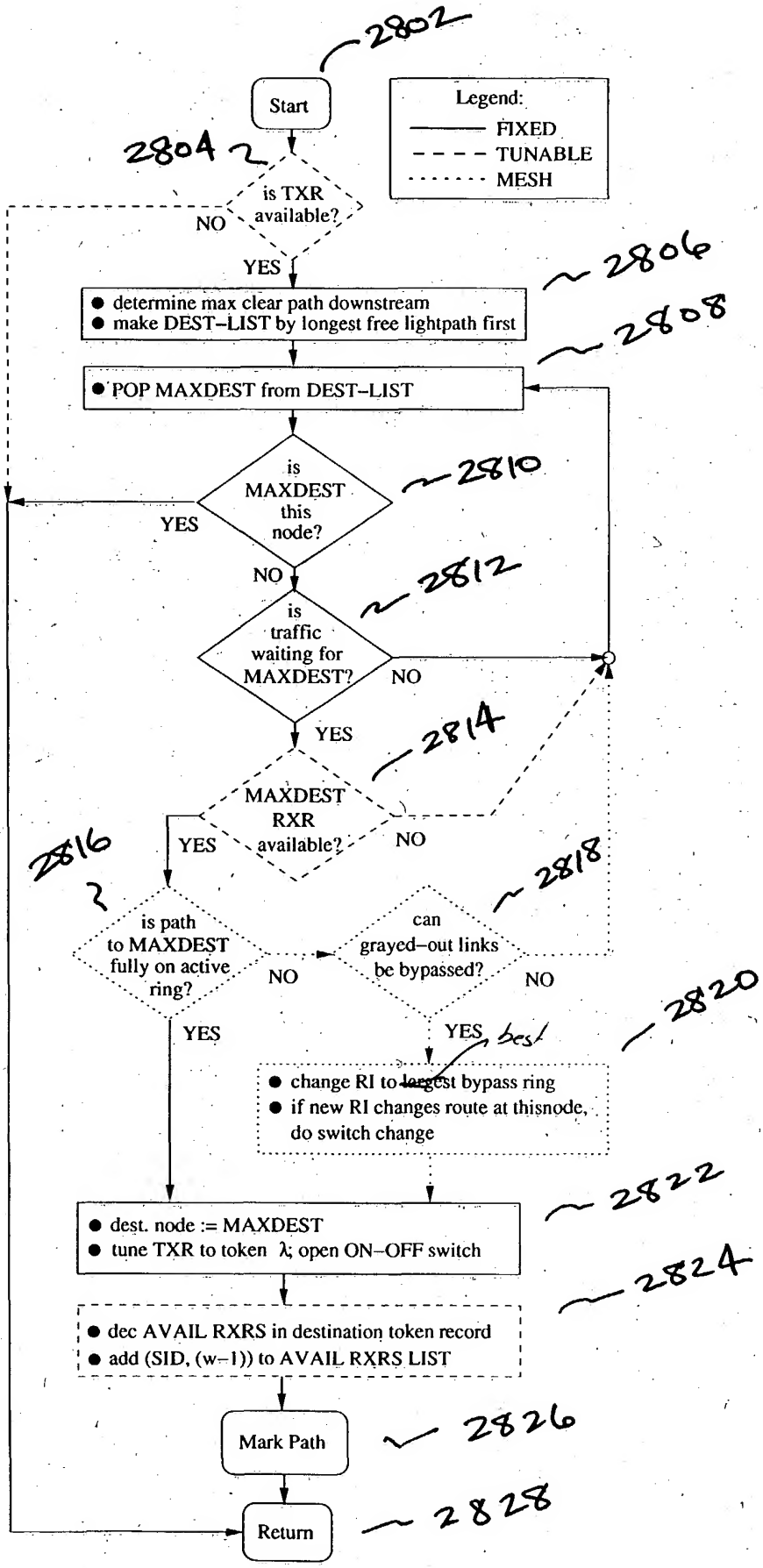
**for each** $rec \in Node.add\_back\_rxr\_list$ [block 2]
**do**
- increment $rec.adj$
- increment $Token[rec.sink]$.AVAIL_RXRS
- **if** $Token[rec.sink]$.NUM_FAILS $> 0$
  - **then** decrement $Token[rec.sink]$.NUM_FAILS
- **if** $rec.adj = 0$
  - **then** delete $rec$

**for each** $rec_1 \in Node.take\_away\_rxr\_list$ [block 3]
**do**
- decrement $rec_1.adj$
- decrement $Token[rec_1.sink]$.AVAIL_RXRS
- **if** ($Token[rec_1.sink]$.AVAIL_RXRS + $Token[rec_1.sink]$.NUM_FAILS) $< 0$[a]
  - **then**
    - increment $Token[rec_1.sink]$.NUM_FAILS
    - **if** *sink* noted **and** $rec_1.sink = sink$ **and** $Token[rec_1.sink]$.LINK $=$ SINK[b]
      - **then if** no active TXN to *sink*
        - **then**
          - **comment:** TANDEM
          - $Node.on\_off[\lambda_i] \leftarrow$ ON
      - **else if** $Token[sink]$.LINK_URG $\geq$ urgency of least urgent active TXN
        - **then**
          - **comment:** STOMP
          - $Node.on\_off[\lambda_i] \leftarrow$ ON
          - discontinue own least urgent active TXN
          - invoke *Failed_TXN()*
        - **else**
          - **comment:** SIPHON
          - reset lightpath from *sink* upstream
          - $Node.on\_off[\lambda_i] \leftarrow$ OFF
          - $Token[source]$.TX_FAIL $\leftarrow sink$
- **if** $rec_1.adj = 0$
  - **then**
    - new $rec_2 \leftarrow (rec_1.sink, -(Global.num\_tokens))$
    - add $rec_2$ to $Node.add\_back\_rxr\_list$
    - delete $rec_1$

[a] **if** the sum of the AVAIL_RXRS and NUM_FAILS token fields for $rec_1.sink$ becomes negative ...

[b] **if** $rec_1.sink$ is the sink of a lightpath that was noted near the top of the algorithm ...

2800




FIND PATH (FIXED. TUNABLE MESH)

2900

**Algorithm 0.0.3:** RESERVE LINKS PROCEDURE(*Token*, *Path*)

create priority queue of destination *candidates*, sorted on primary key (most urgent),
and secondary key (greatest hop-length)

**while** (1)

**do**
- **if** queue empty
  - **then return**
- pop *candidate*
- **if** every RSV_URG of path to *candidate* has lower urgency than *candidate* burst
  - **then** drop through WHILE loop

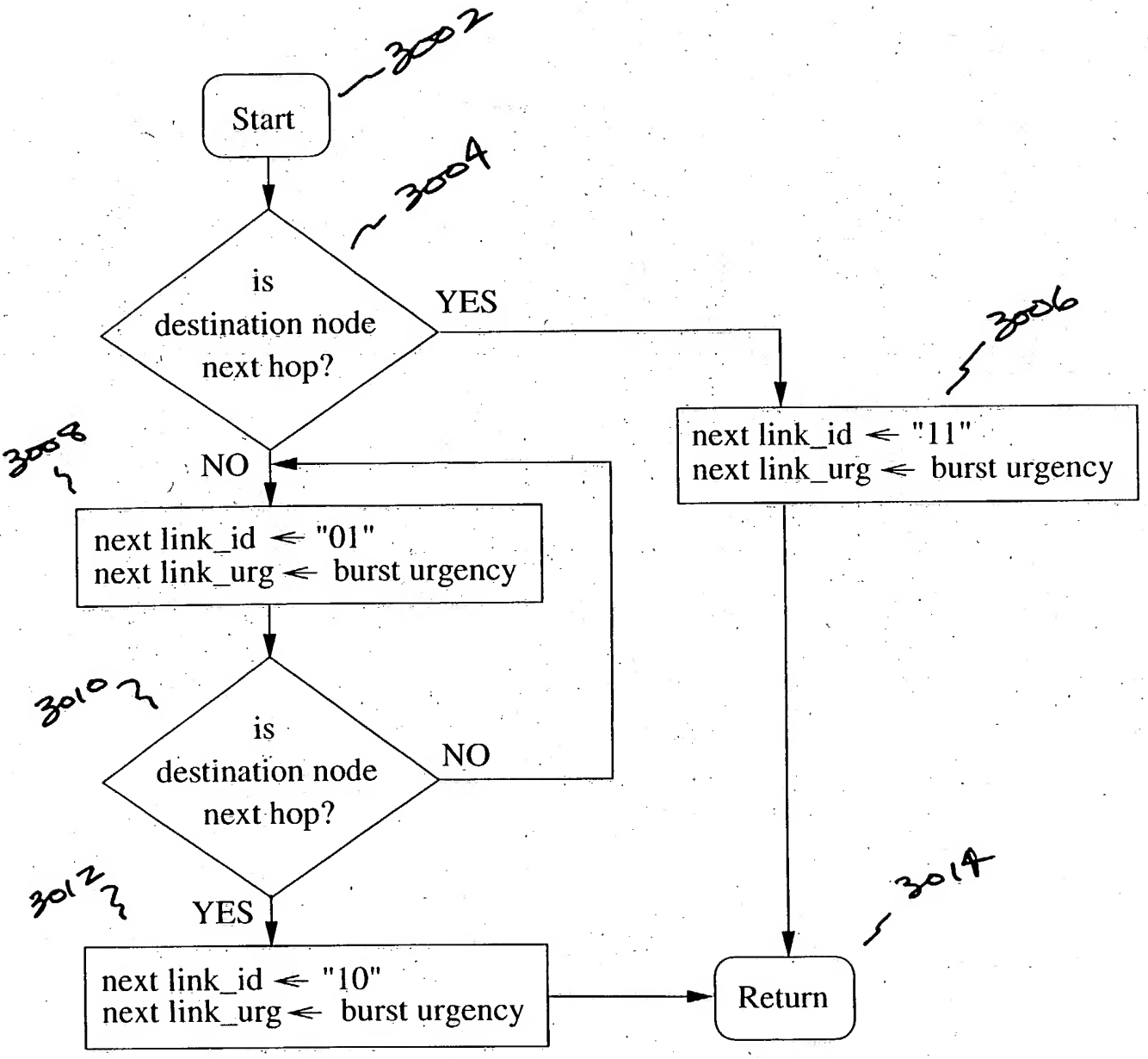
**for each** *link* on *Path*

**do**
- note "losing" reservation ID, if any
- write "my" ID and MAXDEST urgency number

**for each** losing ID

**do**
- reset all reservations which are contiguous to new reservation link
  and which have losing IDs (clear away "orphaned" IDs)

3000




MARK PATH (MARK PATH URGENCY)

3100

**Algorithm 0.0.1:** FIND PATH(*Global*, *Node*, *Token*)

**if** a TXR is available

**then**

- find *max* (the FREE link farthest downstream on *active ring*)
- *dest_list* ← all dests (with bursts waiting) incl. *max*[a]
- sort *dest_list*, by primary key (most urgent) **[3110]**
  and secondary key (farthest)
- **while** (1)
  - **do**
    - **if** *dest_list* is empty
      **then return**
    - *dest* ← pop *dest_list*
    - **if** (∀ intermediate link, (*dest.urg* ≥ *link*.RSV_URG) **[3118]**
      **and** "grayed-out" links can be bypassed) **[3120]**
      **then break**[b]
- **if** "grayed-out" links on path **[3130]**
  - **then**
    - *Token.RI* ← largest available bypass ring (RI)
    - if new RI changes the route at thisnode, set switch
- decrement *Token*[*dest*].AVAIL_RXRS
- *arrec* ← (*dest*, *Global.num_tokens* − 1)
- add *arrec* to *Node.take_away_rxrs_list*
- *mark_path(dest, dest.urg)*

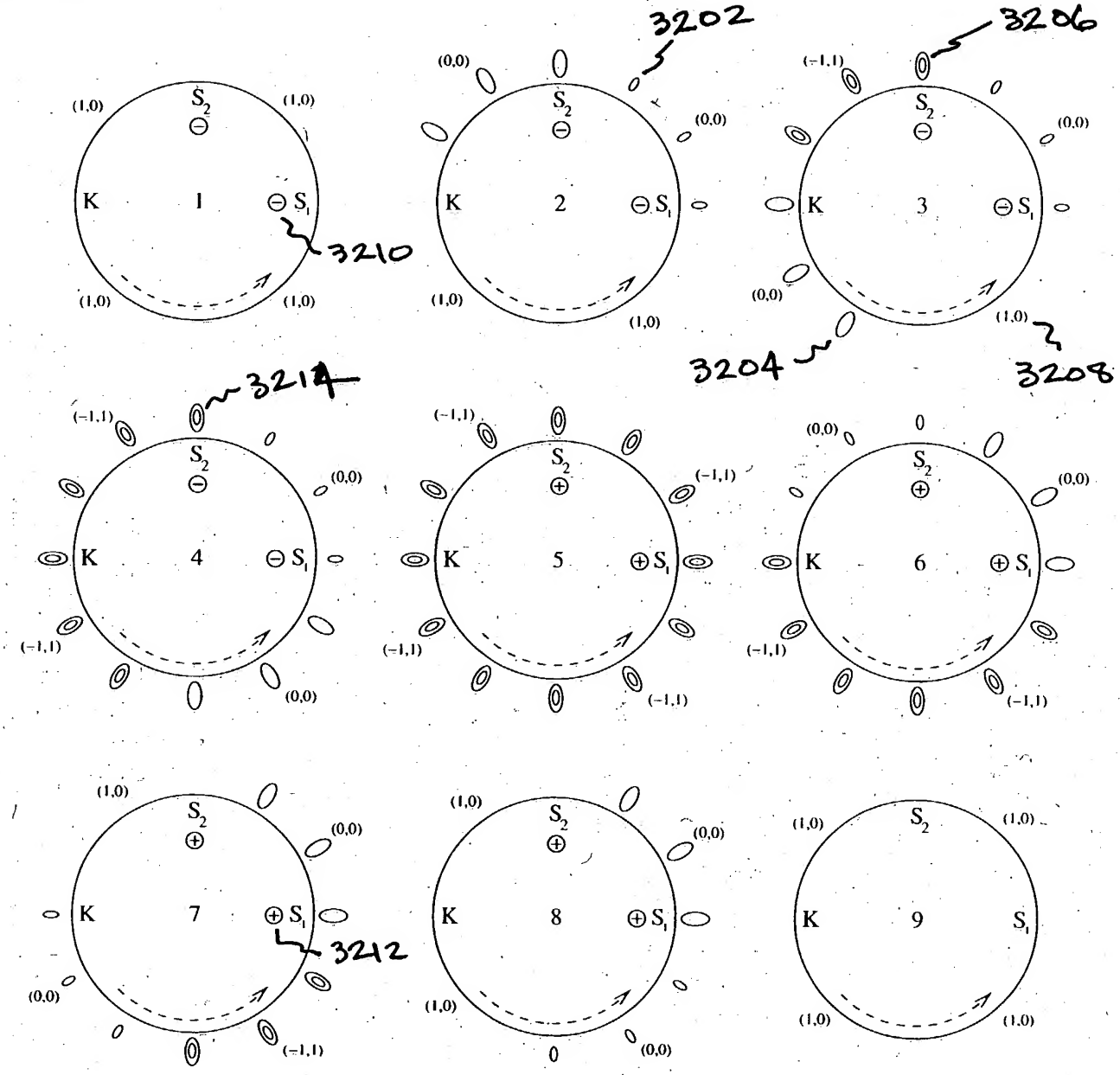
[a] Recall that node information appears on the token in the same record with its upstream link.

[b] The **break** statement is unconditional, except in RESERVATION_SCHEME (first condition) and MESH (second condition).



FIND PATH (URGENCY, RESERVATION)

3200




Phases of receiver accounting

3300

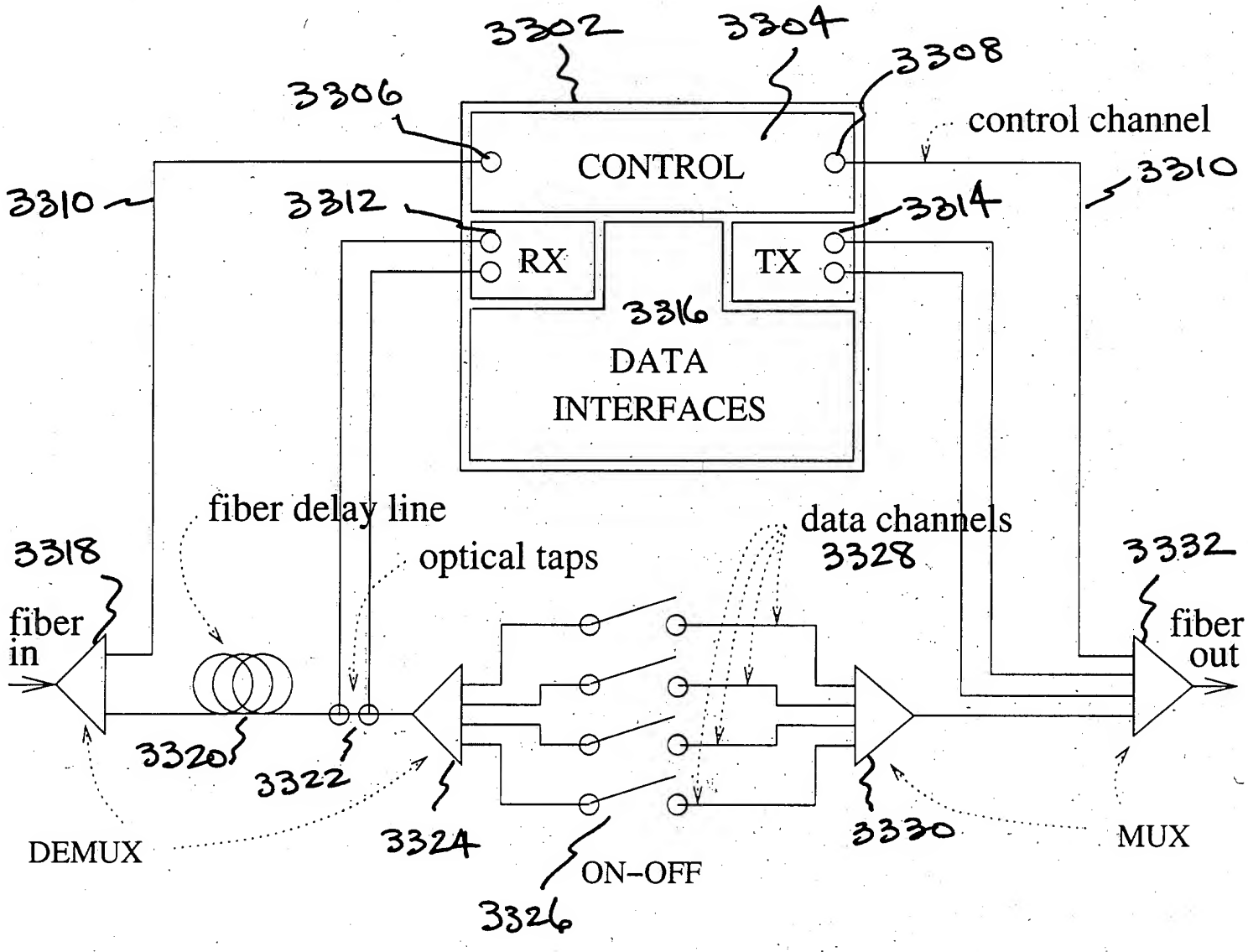



FIG. 33. A low-power mode, exclusive of detection hardware.

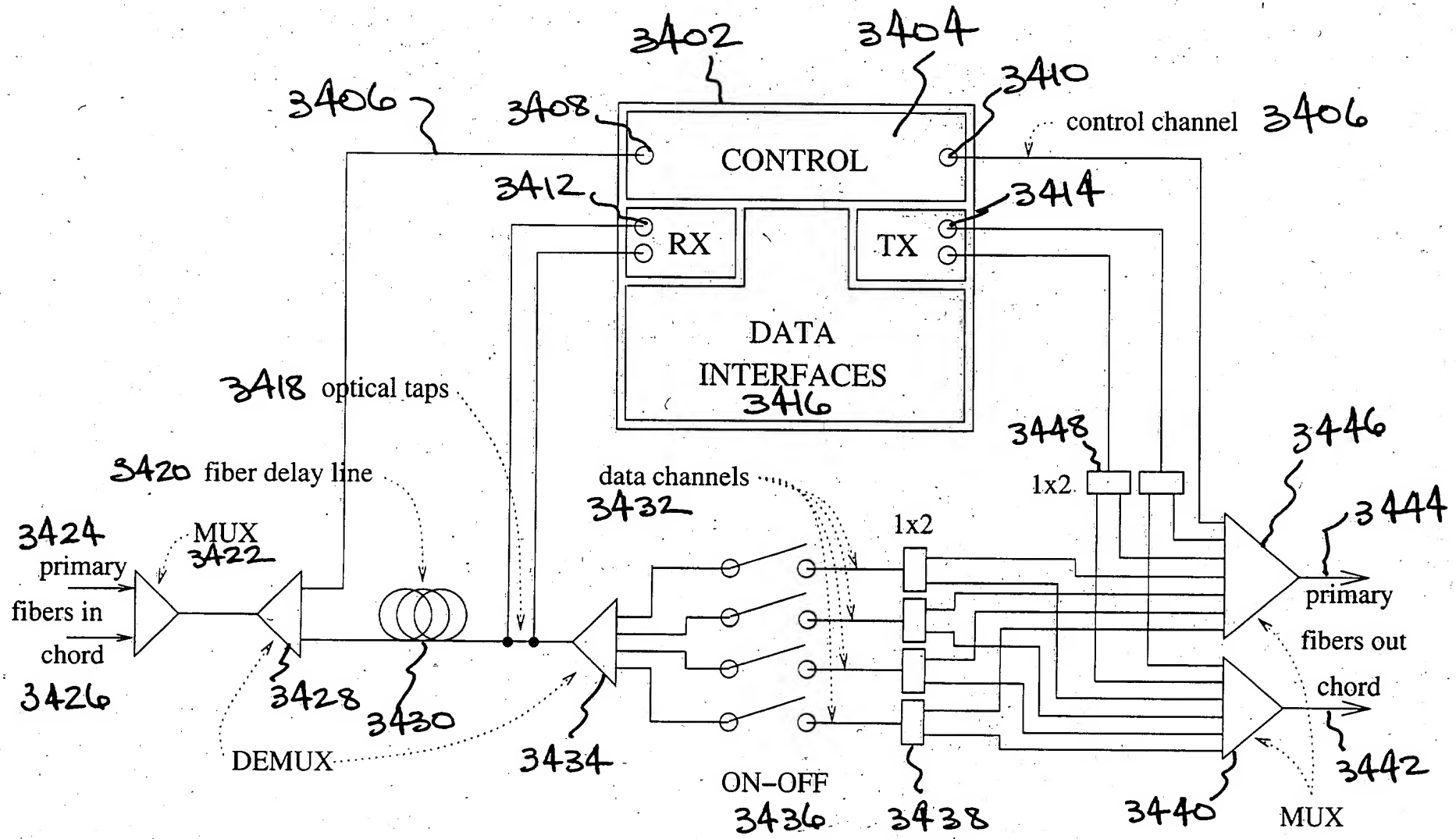



FIG. 34. A low-power node, in a MESH architecture.